AD-A096 690 BOEING AEROSPACE CO SEATTLE WA PRODUCT SUPPORT/EXPER--ETC F/G 5/1
DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS--ETC(U)
NOV 80 D K HINDES, G A WALKER, D H WILSON F33615-77-C-0075
UNCLASSIFIED D194-10089-4 NL

1 OF 2
AD A
096690

LEVEL III

1

AD A 096690

DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST

RESOURCE DEMANDS OF WEAPON SYSTEMS

(ANALYSIS AND RESULTS OF METRICS AND WEIGHTINGS)

DTIC
ELECTE
MAR 23 1981
S D
E

BY

Donald K. Hindes

Gary A. Walker

David H. Wilson

Boeing Aerospace Company
Product Support
Experience Analysis Center
Seattle, Washington 98124

Mr. Frank Maher

LOGISTICS RESEARCH AND TECHNICAL TRAINING DIVISION
AIR FORCE HUMAN RESOURCES LABORATORY
Wright-Patterson Air Force Base, Ohio 45433

INTERIM REPORT

November 1980

D194-10089-4
(Revision A)

DDC FILE COPY

81 3 20 006

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER D194-10089-4	2. GOVT ACCESSION NO. AD-A096	3. RECIPIENT'S CATALOG NUMBER 690
4. TITLE (and Subtitle) Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (Analysis and Results of Metrics and Weightings)		5. TYPE OF REPORT & PERIOD COVERED 1 Dec. 1978 - 1 Oct. 1980
		6. PERFORMING ORG. REPORT NUMBER D194-10089-4
7. AUTHOR(s) Donald K. Hindes, David H. Wilson, Gary A. Walker, Frank Maher		8. CONTRACT OR GRANT NUMBER(s) F33615-77-C-0075
9. PERFORMING ORGANIZATION NAME AND ADDRESS Boeing Aerospace Company, P. O. Box 3999 Product Support/Experience Analysis Center Seattle, Washington 98124		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS HQ Air Force Human Resources Laboratory (AFSC) Brooks Air Force Base, Texas 78235		12. REPORT DATE
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Logistics Research Division Air Force Human Resources Laboratory		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

A-10A	C-141A	Operations Parameters	Maintenance Requirements
B-52G	T-38A	Environmental Parameters	Avionics Equipment
FB-111A	LCOM	Equipment Parameters	Multiple Regression
F-15A	METRICS	Computer Simulation	Task Probability
KC-135A	Engines	Difference Analysis	Failure Clock

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the method and results of the eighth task to "Develop Maintenance METRICS To Forecast Resource Demands of Weapon Systems." The purpose of this task was to perform simulation experiments with existing LCOM aircraft simulators using the newly developed maintenance metrics and weightings in order to validate the techniques and data developed during the course of this study.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

A

The significant results of the analysis and results of metrics and weightings task were:

a) Selection and implementation of the ASD/McDonnell Douglas F-15A LCOM computer simulation as the baseline model with which to perform initial validation experiments on the new maintenance metrics and weightings developed under this study contract.

b) Performance of an initial series of baseline and experimental simulation runs to establish a basis for comparison of the newly developed metrics and weightings for the Phase I study equipments (engines and avionics) with the metrics and weightings currently used in the F-15A LCOM. These simulation experiments tested the fidelity of the maintenance metrics predictor equations using the 1977 F-15A/Bitburg Air Base data base.

c) Performance of an initial difference analysis of the newly developed versus currently used metrics and weightings based on the initial series of experimental simulations. This initial analysis indicated that the LCOM Failure Clock models developed for avionics were able to recreate baseline simulation conditions within an acceptable degree of variability. The average percent difference of 25 selected critical output variables from baseline values was 8.25%. The engine failure clock model exhibited a lower degree of estimation accuracy, however, and indicated the need for further refinement. In this case, the average percent difference of the 25 outputs from baseline values was 61.83%.

d) Selection and implementation of the ASD KC-135A LCOM computer simulation for a series of experiments which compared current maintenance metrics with the new metrics for three different KC-135A bases in different geographical locations and environments. These bases were Loring AFB, Maine; Seymour-Johnson AFB, North Carolina; and Castle AFB, California.

e) Performance of series of calibration and experimental runs for each of the selected KC-135A bases. These experimental series established simulated steady-state operation and maintenance (O&M) conditions at each base under equipment failure rates controlled in turn by (1) existing ASD standard failure clock values, (2) maintenance metrics derived failure clock values, and (3) 1977 actual base-specific data derived failure clock values.

f) Performance of difference analyses on the above series of runs. These compared the simulation results which used the standard ASD metrics and the results using the new failure predictor equations against the baseline simulation results obtained by using the actual 1977 KC-135A failure data from Loring, Seymour-Johnson, and Castle Air Force Bases. The findings are summarized as follows:

Average percent differnce of the 25 selected critical output variables from the 1977 baseline simulated values was - -

	Using ASD Std Failure Clocks	Using Maint. Metrics Derived Failure Clocks
Loring AFB:	- 2.39%	- 2.85%
Seymour-Johnson AFB:	- 8.26%	- 8.93%
Castle AFB:	+ 1.02%	- 2.79%

f) Continued
Selected output variables from the baseline simulations of each base were compared to actual 1977 O&M histories from G033B and D056E data for these bases. This test of the overall fidelity of the ASD KC-135A LCOM simulation indicated an average difference of approximately 10% between LCOM simulation results and 1977 actuals over the three KC-135A bases tested. This fidelity was very acceptable when it is considered that the ASD standard simulation resource base was not tailored to fit the conditions at each specific base.

The findings ~~from (e) and (f) above~~ indicate that the new maintenance metrics predictor equations can provide acceptable estimations of overall aircraft maintenance demand rates under a wide variety of equipment, operational, and environmental characteristics. These general models could be used for predicting equipment failure rates in many user situations such as LCOM analyses and new aircraft concept definition.

This document is the fourth of a series of five Boeing Technical Reports generating from this study, namely:

D194-10089-1 Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (Phase I - Analysis and Evaluation)

D194-10089-2 Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (Parameter Prioritization)

D194-10089-3 Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (Maintenance Metrics and Weightings)

D194-10089-4 Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (Analysis and Results of Metrics and Weightings)

D194-10089-5 Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems (METRICS Final Report)

SUMMARY

This report describes the results of the eighth task of an eight task study. The total effort is intended to develop more accurate metrics and weightings to be incorporated into the Air Force method (Logistics Composite Model (LCOM)) for determining manpower and other resource requirements for operational and developing weapon systems. The eight study tasks comprising this study were as follows:

Task I	Review of Related Research (Boeing document D194-10089-1)
Task II	Select Equipment for Investigation (Boeing document D194-10089-1)
Task III	Identify Parameters for Investigation (Boeing document D194-10089-1)
Task IV	Identify, Obtain, and Integrate Study Data (Boeing document D194-10089-1)
Task V	Analyze and Prioritize Parameters (Boeing document D194-10089-2)
Task VI	Maintenance Metrics Development (Boeing document D194-10089-3)
Task VII	Maintenance Weightings Development (Boeing document D194-10089-3)
Task VIII	Analysis and Modification of Metrics and Weightings (Boeing document D194-10089-4)

PROBLEM

The increased concern with the manpower required to support weapon systems currently in operation, as well as those in development has created the need for more accurate methods of projecting maintenance requirements. Meeting this need requires the development of realistic measures of maintenance rates for all of the diverse hardware that makes up a weapon system. In addition, the impact of operations and environmental conditions needs to be identified to insure the sensitivity of the maintenance metrics that are developed.

To date, the manpower and other resource requirements essential to the Operations and Support of a weapon system have been determined using the traditional "flying hours" and "sortie rate" measures. The deficiencies of these traditional measures are well known and such measures frequently are found to be totally irrelevant; for example, many avionics items operate or are cycled greatly in excess of the related flying hours. These traditional measures are also insensitive to variations in operations and environmental conditions. The present difficulties then lie in the fact that the currently used metrics do not consider the inherent differences between the individual subsystems of a weapon system and are relatively insensitive to operational and environmental conditions.

The problem for this portion of the study was to plan and execute a series of validation experiments for the new metrics and weightings models developed during the preceding study tasks. The testing of these new metrics and weightings must be performed in the context of actual operative LCOM simulations if the validation is to have credibility. They must be transformed to Failure Clock Values required to drive the Maintenance Networks of selected LCOM simulations so that comparisons may be made between these new metrics and those currently in use.

APPROACH

The approach taken for this portion of the study effort was to select and implement existing baseline LCOM simulations to use as vehicles for the calibration and validation experiments on the maintenance metrics models developed in preceding study tasks VI and VII (see Boeing document D194-10089-3). The initial model selected was the ASD/McDonnell Douglas LCOM simulation of the F-15A aircraft at Bitburg Air Base, Germany. A series of calibration runs of baseline model were executed using the failure clock and task selection probability standards developed from the historical F-15A/Bitburg data base. Experimental runs were then executed with failure clock values based on the generalized metrics models developed during the course of this study. Comparisons were then made between the experimental and calibration simulation results and an evaluation made of the success of the new generalized metrics in receating the specific historical conditions portrayed by the calibration simulation runs. Determination was then made of the acceptability or need for modification and refinement of the newly developed metrics.

Subsequent series of experiments were then planned and executed using the standard ASD KC-135A LCOM simulation. This simulation was implemented with the scenarios from three widely separated and environmentally different bases; i.e., Loring AFB, Maine; Castle AFB, California; and Seymour-Johnson AFB, North Carolina. Calibration and experimental runs were then made for each base first using the standard values, then the study predicted values for failure clocks, and finally failure clock values derived from actual operational and failure data from the three bases. Comparisons were then made between the simulation results from the standard runs, the new metrics runs, and the actual metrics runs. These sets of results were then compared with actual historical performance data from the subject bases to determine which type of metric yielded results closest to actual historic values, and to check the general fidelity of the LCOM simulation used in the experiments.

RESULTS

The foregoing approach was initially applied to the maintenance action demand estimating models developed during the Phase I portion of the study for aircraft propulsion and avionics subsystems. These MAD estimating models (see Boeing document D194-10089-3 for a discussion of the development of these models) were used to transform the appropriate failure clock values in the baseline F-15A LCOM simulation data base to new values based on the equipment, operational, and environmental parameters contained in the models. The MAD estimating models were used to compute new F-clock values for the F-15A/Bitburg LCOM simulation as follows:

(1) Values for the various equipment, operational, and environmental parameters included in the MAD estimating equations were obtained from the F-15A/Bitburg data base which was obtained during the course of the study. These values comprised the "operating point" for the model; i.e., F-15A/Bitburg Air Base equipment, operational, and environmental characteristics.

(2) The linear multiple regression equations comprising the MAD estimating models were then evaluated to obtain an estimate for maintenance action demand per aircraft per year for each aircraft subsystem analyzed (initially propulsion and eleven avionic subsystems). These MAD per aircraft per year estimates were then transformed into mean-sorties-to-failure estimates for each subsystem.

(3) The mean-sorties-to-failure values from (2) were then used to change the appropriate F-clock values in the main simulation model by means of "change cards" in the run control deck.

An initial series of LCOM simulation experiments were performed to evaluate the Phase I maintenance metrics and weightings. The objective of these experiments was to determine how well the generalized MAD estimating models, which were derived from an Air Force-wide population of aircraft and bases, could duplicate actual historical MAD data from a specific aircraft (the F-15A) and a specific base (Bitburg Air Base, Germany). This determination is a measure of the confidence that can be placed in the new metrics and weightings when used in a new situation for an emerging weapon system. The determination was made by exercising the F-15A/Bitburg LCOM simulation with the new F-clock values singly and in combination. The results of these simulations were then compared to baseline model runs to determine how well the F-clock values based on estimated data could duplicate simulation results from F-clock values based on actual historical data.

It was found that the new metrics and weightings developed for the eleven avionic systems were able to duplicate actual historical results within plus or minus 10 percent. These estimating models can therefore be used for predicting maintenance action demand in unknown situations with a high degree of confidence.

The MAD estimating model for the propulsion system yielded large deviations in simulation results compared to historical MAD values. Therefore this model requires modification and/or refinement before it can be used with confidence.

The validation experiment approach outlined above was next applied to the ASD KC-135A LCOM simulation for three different bases. These bases were Loring AFB, Maine, an operational SAC base in a cold, damp climate; Castle AFB, California, a SAC training base in a hot, dry climate; and Seymour-Johnson AFB, North Carolina, an operational SAC base in a warm, damp climate. The three bases were chosen to demonstrate the ability of the new metrics to reflect the differences in operations and environments at the bases.

Series of simulation experiments were performed to evaluate the generalized metrics models developed for the 30 common aircraft subsystems selected for Phases I and II of the study. The simulations of the three bases were first run using the metrics currently used by ASD. Then the new metrics model values were substituted and the simulation runs repeated. Finally, metrics based on actual 1977 operational and failure data from the three bases were inserted and the series of simulations repeated once more to form an LCOM output baseline based on base-specific, historic inputs.

The results of the ASD standard runs and the metrics model runs were compared against the results of the baseline runs. These difference analyses determined and demonstrated the capability of the generalized maintenance metrics model inputs relative to the ASD standard inputs for producing similar LCOM outputs to actual base-specific inputs. The analyses findings are summarized as follows:

Average percent difference of the 25 selected critical output variables from the 1977 baseline simulated values was - -

	Using ASD Std Failure Clocks	Using Maint Metrics Derived Failure Clocks
Loring AFB:	- 2.39%	- 2.85%
Seymour-Johnson AFB:	- 8.26%	- 8.93%
Castle AFB:	+ 1.02%	- 2.79%

These findings demonstrate that the generalized metrics models are quite acceptable for synthesizing F-clock inputs for the ASD KC-135A LCOM.

Selected output variables from the baseline simulation series of each base were then compared to actual 1977 O and M histories from G033B and D056E data for these bases. This tested the overall fidelity of the ASD KC-135A LCOM simulation used in the experiments (this simulation used a standard ASD resource data base instead of resources tailored to fit the conditions at each specific base). The findings of these comparative analyses were as follows:

Seven critical O and M performance parameters were selected for comparison, i.e. - -

- Flying Hours Per Aircraft Per Year
- Sorties Per Aircraft Per Year
- Average Operational Ready Rate
- Average Not-Operationally-Ready-Maintenance Rate
- Average Not-Operationally-Ready-Supply Rate
- Total Maintenance Manhours Per Aircraft Per Year
- Average Maintenance Manhours Per Flying Hour

The average percent deviation of these parameters as simulated by the baseline series runs of the KC-135A LCOM were as follows:

Loring AFB:	-	7.45% average deviation
Seymour-Johnson AFB:	-	9.57%
Castle AFB:	-	14.08%

This fidelity was considered completely acceptable in light of the standard, non-specific configuation of the KC-135A LCOM simulation resource base.

PREFACE

This report was prepared by the Boeing Aerospace Company Product Support/Experience Analysis Center (PS/EAC), Seattle, Washington, under USAF Contract F33615-77-C-0075. This contract was initiated unded Exploratory Development Area PMS 77-43 (1124). Work was accomplished under the direction of the Logistics Research Division of the Air Force Human Resources Laboratory, Air Force Systems Command with Mr. Frank Maher as the project scientist.

Data emanating from this contract, "Development of Maintenance METRICS To Forecast Resource Demands of Weapon Systems," are reported in a series of five Technical Reports. Phase I of the study provided the identification of aircraft avionic and engine maintenance resource demands which were used to develop more accurate metrics and weightings for incorporation into the Air Force Logistics Composite Model (LCOM). Phase II of the study provides metrics and weightings for the rest of the subsystems making up a typical Air Force aircraft.

Experience Analysis Center program technical leader was George R. Herrold. Principal program analysts were Donald K. Hindes, Gary A. Walker, and David H. Wilson. Boeing's contract report number is D194-10089-4. This approved technical report (TR) includes work performed from 1 December 1978 through 1 October 1980.

The Boeing Aerospace Company wishes to express their appreciation for the technical assistance and data provided by: a) AFLC Headquarters, Aeronautical Systems Division, and Air Force Maintenance and Supply Management Engineering Team, Wright-Patterson AFB, Ohio, b) Air Weather Service (MAC) Environmental Technical Applications Center and Military Airlift Command Headquarters, Scott AFB, Illinois, c) Air Force Europe Headquarters, Ramstein AB, Germany, d) Air Training Command Headquarters, Randolph AFB, Texas, e) Strategic Air Command Headquarters, Offutt AFB, Nebraska, f) Tactical Air Command Headquarters, Langley AFB, Virginia, g) 12th FTW, Randolph AFB, Texas, h) 36th TFW, Bitburg AB, Germany, i) 58th TTW, Luke AFB, Arizona, j) 60th MAW, Travis AFB, California, k) 92nd BMW, Fairchild AFB, Washington, l) 35th TFW, Myrtle Beach AFB, South Carolina, m) 355th TFW, Davis-Monthan AFB, Arizona, n) 380th BMW, Plattsburgh AFB, New York, o) 42nd BMW, Loring AFB, Maine, p) 68th BMW, Seymour Johnson AFB, North Carolina, and q) 93rd BMW, Castle AFB, California.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

I - INTRODUCTION

1. PURPOSE AND SCOPE

This report is the fourth of five reports to be completed under the Maintenance Metrics study. It describes the work accomplished during Phases I and II for Task VIII as displayed in Figure 1 and enumerated below. Tasks I through VII were completed previously and documented in the first three reports in this series, D194-10089-1, D194-10089-2 and D194-10089-3.

The significant results obtained in this task provide the initial validation data for the Maintenance Metrics models developed in previous tasks and also provide source data for related future research.

The following is a brief overview of the eight tasks developed for this study as shown in Figure 1.

TASK I	Identify, Obtain, and Review Related Publications - review related studies and research dealing with maintenance rates and causes.
TASK II	Select Equipment - develop matrices of equipment by aircraft type in order to select specific hardware for avionics and engines subsystems.
TASK III	Identify Parameters - identify maintenance, hardware, operational, environmental, and aircraft general parameters which would have an impact on maintenance for the subject subsystems.
TASK IV	Identify and Integrate Data Sources - identify, assemble, correlate, and integrate the data base on the equipment selected in Task II for the related parameters being considered in Task III.
TASK V	Analyzing and Prioritizing Parameters - prioritize the collected data to define and test relationships between the study parameters and maintenance demand rates.
TASK VI	Maintenance Metrics Development - develop metrics quantifying maintenance demand rates which are computable with LCOM models.

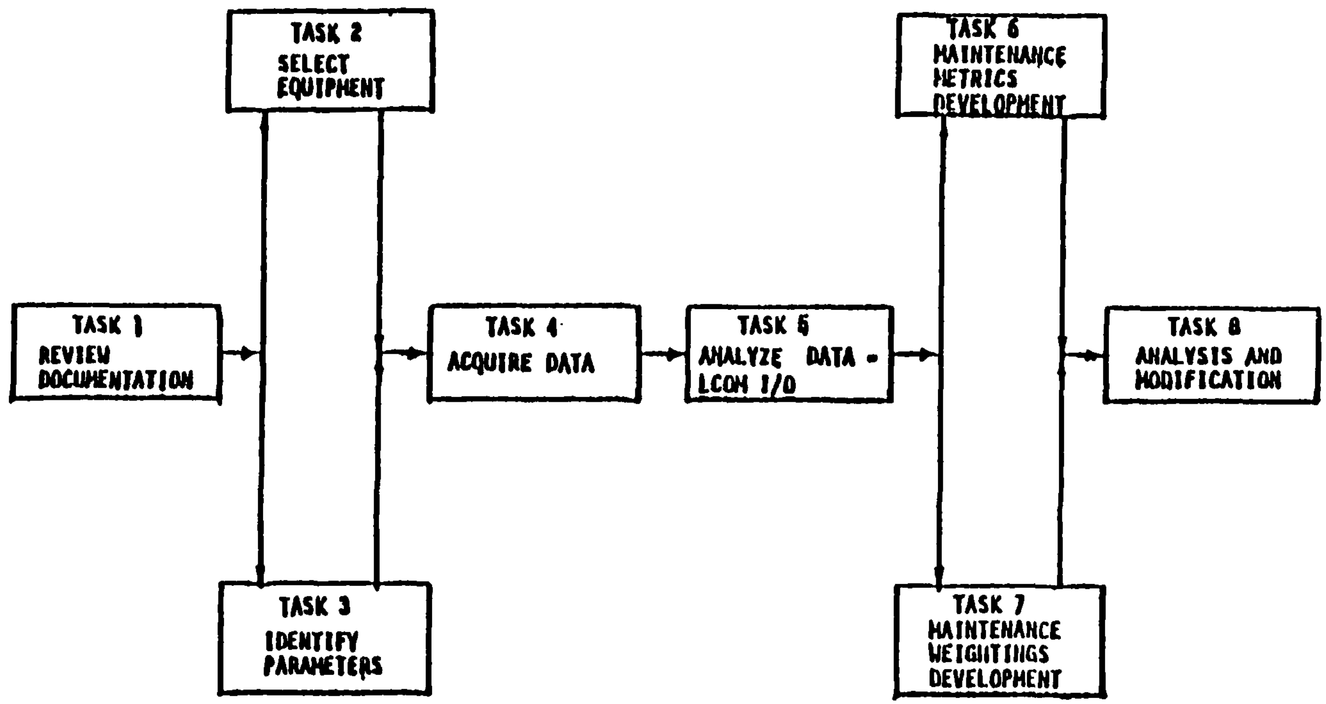

FIGURE 1 STUDY TASKS FLOW DIAGRAM

TASK VII	Maintenance Weightings Development - develop weightings, quantifying identified impacts upon maintenance demand rates.
TASK VIII	Analysis and Modification - analyze LCOM model outputs with current and the newly developed metrics and weightings.

2. BACKGROUND

To date, the manpower and other resource requirements essential to the Operations and Support (O&S) of a weapon system have been determined using the traditional "flying hours" and "sortie rate" measures. The deficiencies of these traditional measures are well known and such measures frequently are found to be totally irrelevant (e.g., maintenance on a gun subsystem is generated by factors like the number of rounds fired, and is not affected by the number of flying hours or sorties). These traditional measures are also insensitive to variations in operations and environmental conditions (for example, many avionics equipments may operate or are cycled on the ground greatly in excess of related flying hours or number of sorties). The present difficulties then lie in the fact that the currently used metrics do not consider the inherent differences between the individual subsystems of a weapon system and are relatively insensitive to operational and environmental conditions.

The objective of this portion of this research study is to perform initial validation experiments utilizing the maintenance metrics models derived during this study to generate maintenance demand inputs for the Air Force Method (Logistics Composite Model (LCOM)) for determining manpower and other resource requirements for operational and developing weapon systems. This simulation technology has been documented in References 1 through 9.

3. SUMMARY

The approach taken for the validation of the maintenance metrics developed during the preceding study tasks was to exercise the newly developed metrics in known historical situation simulations and subsequently evaluate the success of these new metrics in producing similar simulation results as the actual historical data. The ability of the new maintenance metrics to duplicate the results of actual historical data is a measure of the worth of these metrics in predicting maintenance resource demands for emerging weapon systems under new operational and environmental conditions.

Initial validation experiments were performed using the ASD/McDonnell Douglas LCOM simulation of the F-15A aircraft at Bitburg Air Base as the baseline model. This model was executed with the standard failure clock values which were derived from the historical data base on F-15A/Bitburg. Then a series of experimental simulation runs were executed using the maintenance metrics and weightings developed during this study to set the model's failure clocks. These experimental runs were designed to demonstrate the effects of the new metrics singly and in combination. The results of the experimental simulations were then compared with the standard simulations in order to evaluate the worth of the newly developed maintenance metrics for the estimation of aircraft systems maintenance resource demands.

In the initial series of experimental model runs, maintenance metrics for the aircraft propulsion system and eleven avionic systems were exercised. The results of this initial series indicated that the avionics metrics were acceptable for use in predicting new situations with only approximately 10% deviation from the simulation results given by the actual historical data. The propulsion system metric indicated a need for further investigation and possible refinement, however, since its introduction into the baseline simulation model caused wide variations from the actual historical propulsion data.

A more extensive series of validation experiments was then performed which exercised the developed metrics for all thirty aircraft subsystems investigated. A standard LCOM simulation of the KC-135A aircraft was used to simulate three different bases with varying environments and operational modes, i.e.; Loring AFB, Maine, a two squadron operational base; Seymour-Johnson AFB, North Carolina, a single squadron operational base; and Castle AFB, California, a two squadron training base. These squadrons were first simulated using the ASD developed standard metrics with base-specific flying programs. Then the simulations were repeated using the newly developed maintenance metrics from this study. Finally, the simulations were repeated again using metrics based on the historic 1977 sortie and failure rates from the bases in question to form base-specific baseline simulations. Output operational and maintenance parameters from the standard and "new" metrics simulations were then compared to the baselines to check the success of these metrics in simulating base-specific situations. The outputs of the baseline simulations were in turn compared to actual 1977 O&M histories at the subject bases as extracted from the Air Force G033B and D056E data systems. These comparisons measured the overall fidelity of the ASD KC-135A LCOM in reproducing actual base conditions.

The results of these comparative analyses indicated that the newly developed maintenance metrics were approximately equal in accuracy to the ASD developed standard KC-135A metrics as measured against base-specific baseline metrics. Both types produced simulated outputs that were generally within 3% of the baseline outputs for Loring and Castle AFB's, and within 9% for Seymour-Johnson AFB. The advantage of using the new metrics over standard methods is apparent in new situations where standard metrics do not exist. The standard metrics are synthesized from combining a great deal of field failure data and take a significant time to develop, whereas the new metrics are simply the result of inserting a small amount of parametric data into the failure predictor equations and computing the predicted equipment failure rates. This can usually be done quickly and easily for any aircraft/base situation given the general maintenance metrics data base and access to G033B and D056E data.

The overall fidelity of the KC-135A LCOM as compared to actual 1977 field data indicated acceptable levels of under 10% deviation for Loring and Seymour-Johnson AFB's, and under 15% deviation for Castle AFB.

II - ANALYSIS AND RESULTS OF METRICS AND WEIGHTINGS - TASK VIII

1. INTRODUCTION

Task VIII of the study was the planning, execution, and analysis of validation experiments for the new maintenance metrics and weightings developed during the preceding study tasks. These experiments were performed on operative LCOM simulations of operational aircraft systems. The validation experiments were intended to demonstrate the validity of the new metrics and to set an approximate confidence level for their use.

The task results reported herein cover the validation efforts for both Phase I metrics (propulsion and avionics) and Phase II metrics (other aircraft systems).

The subtasks accomplished for the preparation and execution of these validation experiments are as shown in Figure 2 and discussed in the following paragraphs. The task sequence implied by the flow shown in Figure 2 is approximate. Portions of several of subtasks were actually accomplished in parallel. Figure 3 depicts the general validation experimental procedure.

2. SELECTION OF BASELINE LCOM INPUT MODEL - SUBTASK 8.1

The first step in the process of analyzing the results of metrics and weightings development effort of the preceding study tasks was the selection of operative LCOM simulations in which to test the newly developed metrics. Existing Air Force LCOM simulations were investigated and the ASD/McDonnell Douglas model of the F-15A aircraft at Bitburg Air Base selected for the initial series of metrics validation experiments. The model selected for subsequent series of experiments was the standard ASD model of the KC-135A aircraft.

Input models and flying programs for the selected models were implemented on the ITEL computer system in the ASD Computer Center at Wright-Patterson Air Force Base, Dayton, Ohio. The model data were based on 1977 experience data the same as the present study.

3. BASELINE MODEL SIMULATION RUNS USING CURRENT METRICS AND WEIGHTINGS - SUBTASK 8.2

After implementation of the baseline models on the ASD computing system, simulation runs were executed using the failure clock values and maintenance task selection probability distributions currently operational in the input data bases for the models. These runs served to calibrate the natural variability of the baseline simulations and to establish a basis for comparison of the results of the later validation experiments which utilized the newly developed F-clock metrics.

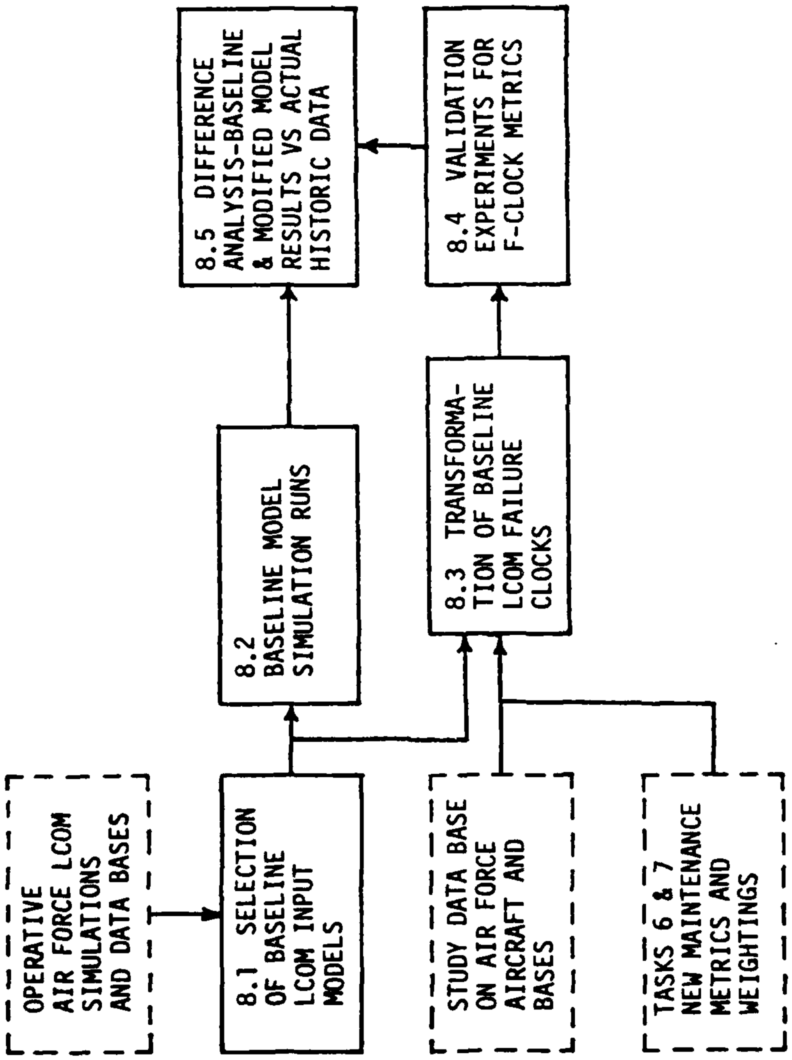

FIGURE 2 TASK VIII PROCESS FLOW

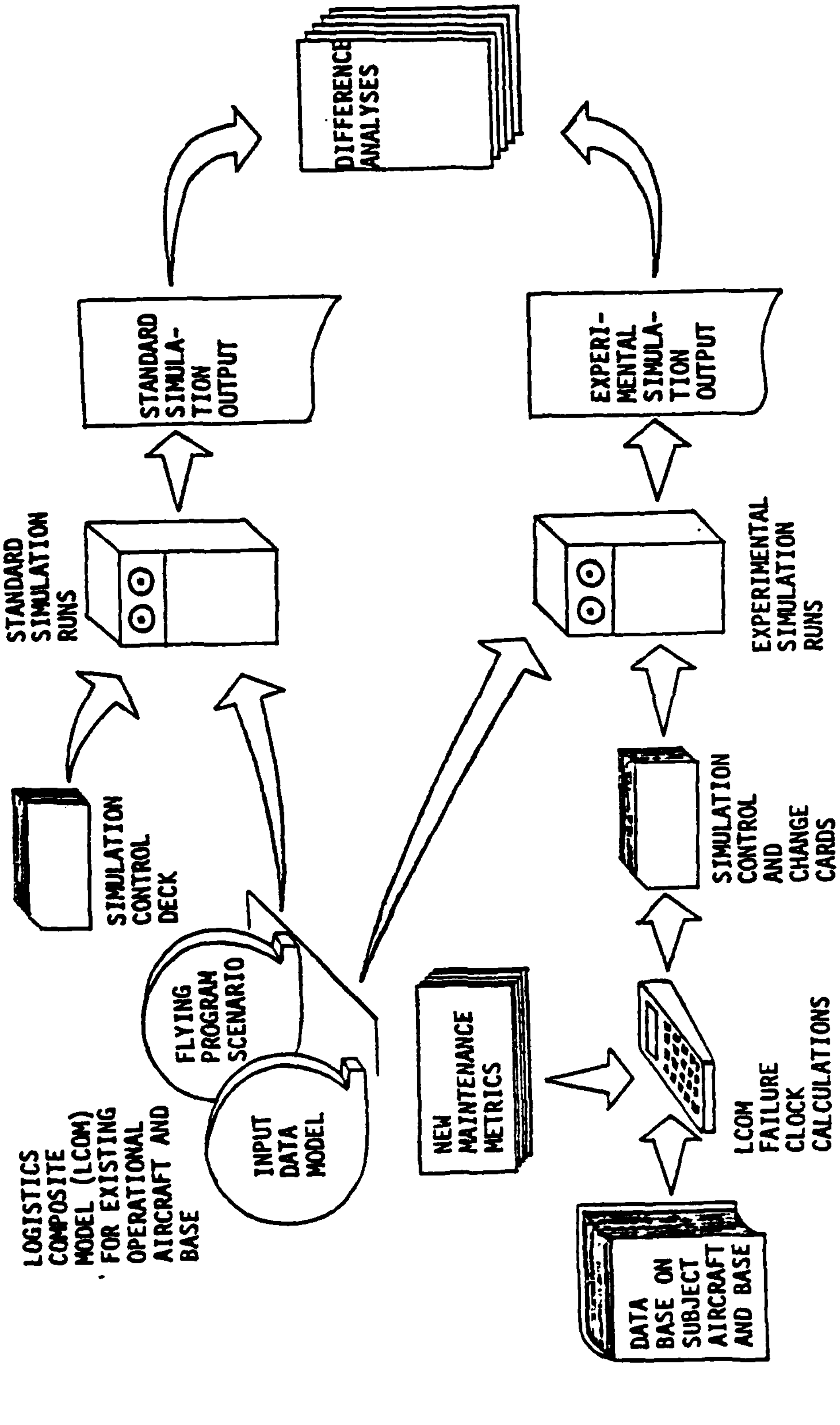

FIGURE 3 MAINTENANCE METRICS VALIDATION EXPERIMENT PROCEDURE

4. PROCEDURE FOR TRANSFORMING BASELINE LCOM FAILURE CLOCKS - SUBTASK 8.3

The next step of the validation process was to implement a procedure for transforming the baseline failure clock values in the test models to values computed from the F-clock estimation equations developed in preceding study tasks VI and VII. The procedure developed utilized the "change-card" capability of the LCOM control software so as to facilitate ease of testing various combinations of modified clock values without disturbance to the basic baseline Input Data Model. This procedure is as follows:

PROCEDURE FOR TRANSFORMING PRESENT LCOM FAILURE CLOCK VALUES TO CONFORM WITH MAINTENANCE METRICS MODEL ESTIMATES

(1) Determine actual historical time period used to derive present LCOM values.

(2) Determine actual maintenance action demand (AMAD) of item of interest during that time period.

(3) Determine appropriate "operating point"[1] values for item's Metrics Model regression variables. These values may either be derived from historic design and scenario data or from new simulated design and scenario data as appropriate depending on the nature of the simulation experiments to be performed.

(4) Compute estimated maintenance action demand (EMAD) for the same historic time period using Maintenance Metrics Regression Model.

(5) Compute ratio of EMAD to AMAD.

NOTE:

1 - Operating point is defined here as the system of design, operational support, and environmental conditions applicable to the item-of-interest. This may be some actual historic operating point featuring retrospective data, a predicted operating point featuring prospective estimates, or it may be a mixture of the two.

(6) Multiply present clock values (or decrement value if appropriate) by the EMAD/AMAD ratio to transform clock value to the Maintenance Metric based estimate.[2]

(7) If new clock value is to be substituted into an existing LCOM input model and it is desired not to disturb the existing input data base, add a clock change card to the LCOM simulation control deck designating the appropriate clock number and new clock value.

A typical example of the application of this procedure to the F-15A/Bitburg baseline LCOM is as follows:

EXAMPLE OF FAILURE CLOCK TRANSFORMATION PROCEDURE:

Assume that there exists a failure clock for the F-15A Flight Indicators Subsystem (WUC-51A) which is based on 1977 maintenance demand and sortie data from Bitburg Air Base.

Step 1 Derivation time period = 1977

Step 2 Actual maint. action demand (AMAD) for WUC-51A:

(LCOM definition AMAD per system per year)
(Source: AFM 66-1 (D056E) data for 1977)

LCOM Task Code R = 46 actions/32 systems =	1.43750
LCOM Task Code M = 20 actions/32 systems =	0.62500
LCOM Task Code H = 11 actions/32 systems =	0.34375
Total 1977 AMAD (LCOM Definition)	2.40625

Step 3 1977 values for significant F-15A (WUC-51A) Maintenance Metrics Regression Model variables (Bitburg data):

Equipment Variables:
A03, Equipment Weight . . . . 0.72 lbs.

Operations Variables:
013, Minimum Landing Distance . . . . . . .3750.00 feet
017, Operations Flying Hours per Aircraft . 223.53 hrs./yr.

NOTE:

2 - The Maintenance Metrics Models are of greatest value when performing prospective simulation and analyses on new systems and/or new scenarios. Under these conditions it is postulated that they will provide better results than simplistic projections of historic failures per sortie or per flying hour. If, however, an exact historical scenario is being simulated (a retrospective analysis of what actually happened), the historical data should provide better results than the "fitted" Maintenance Metrics estimates.

Environmental Variables:

E03, Runway Direction . . . . 240.00 compass degree

E19, Maximum Crosswinds 20-29 mph . . . . . 106.00 days/yr.

Step 4 Estimated maint. action demand (EMAD) for WUC-51A: (F-15A Bitburg Situation, 1977)

WUC-51A Maint. Metrics Regress Model: (Derived from data for WUCs 51AD, 51AH, and 51AK)

EMAD = 4.65791+(0.39813)(0.72)+(0.00036)(3750.0)+...
...+(0.00159)(223.53)-(0.00361)(240.0)+(0.04497)(106.0)
EMAD (for 51AD, 51AH, 51AK) = 1.23458 actions per year
AMAD (for 51AD, 51AH, 51AK) = 0.88 actions per yr (from 66-1 data)
Ratio of total 51A AMAD to partial AMAD above:
2.40625/0.88 = 2.73
Total 51A EMAD = (2.73)(1.23458) = 3.376

Step 5 Ratio of total WUC-51A EMAD to AMAD
3.376/2.406 = 1.403

Step 6 Calculation and transformation of baseline failure clock value:

Assume that the baseline WUC-51 failure clock value is based on sorties per failure for the year 1977 with no allowance for peak sortie rate or peak failure rate periods.

Then--Sorties per Failure = Total Sorties per Acft/Total AMAD per unit
= 174.53/2.406
= 72.54

Set baseline F-clock at 73 sorties to failure
Transformed F-clock value = (AMAD/EMAD) (Baseline Clock Value)
= (1.403)(72.54)
= 101.77

Set new F-clock value at 102 sorties to failure by adding a clock change card to the LCOM control deck designating the appropriate clock number and the new clock value.

Initially, the procedure was applied to the propulsion and eleven of the avionics failure clocks of the F-15A/Bitburg baseline model. Figure 4 displays the key to the F-clock transformation worksheet used to record the calculations involved. The completed worksheet of the F-clock transformations for the initial F-15A/Bitburg validation experiments is included as Appendix A. The resulting F-clock values and their implications for the baseline F-15A/Bitburg LCOM are summarized in Table 1. Baseline values for the subject F-clocks had been calculated from 1977 Bitburg data prior to the model's use in the metrics study.

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F CLOCK	MAINT. METRIC MODEL WUC'S	ACTUAL MAINT. ACTION DEMAND PER UNIT PER YEAR					
				LCOM R +	LCOM M +	LCOM H =	TOTAL MAD ÷	NO. UNITS =	AMAD

PARTIAL AMAD (MODEL WUC'S)	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL)																
	A +	(B1 •	X1) +	(B2 •	X2) +	(B3 •	X3) +	(B4 •	X4) +	(B5 •	X5) +	(B6 •	X6) +	(B7 •	X7) =	PEMAD •	$\frac{AMAD}{PAMAD}$ =	TOTAL EMAD

$\frac{AMAD}{EMAD}$ •	PRESENT CLOCK VALUE =	METRIC MODEL ADJUSTED CLOCK

Where: WUC = Work Unit Code
LCOM F Clock = Clock I.D. Number
R = Maintenance Task Code (Remove)
M = Maintenance Task Code (Fix in place)
H = Maintenance Task Code (Check OK)
MAD = Maintenance Action Demand
AMAD = Actual Maintenance Action Demand
Xn = Significant Equipment, Operational, and Environmental Parameters
PEMAD = Partial Estimated Maintenance Action Demand
PAMAD - Partial Actual Maintenance Action Demand
EMAD - Estimated Maintenance Action Demand

FIGURE 4 LCOM FAILURE CLOCK CALCULATION WORKSHEET

TABLE 1

APPLICATION OF METRIC MODELS TO F-15A (BITBURG) LCOM FAILURE CLOCKS (PHASE I EQUIPMENTS)

EQUIPMENT SUBSYSTEM (F15A)	F-15A LCOM F-CLOCK	BASELINE MODEL CLOCK VALUE	METRICS MODEL ADJUSTED CLOCK	DIFFERENCE	PERCENT DIFFERENCE FROM BASELINE	IMPLICATION FOR LCOM
PROPULSION - ENGINE #1	F23000	12	7	- 5	- 41.67	SIGNIFICANTLY HIGHER FAILURE RATE
ENGINE #2	F27000	12	7	- 5	- 41.67	
FLIGHT INDICATORS	F51A00	126	80	- 46	- 36.51	SIGNIFICANTLY HIGHER FAILURE RATE
AIR DATA SUBSYSTEM	F51E00	145	157	+ 12	+ 8.28	INSIGNIFICANT DIFFERENCE
HORIZ SITUATION INDICA.	F51N00	145	142	- 3	- 2.07	INSIGNIFICANT DIFFERENCE
AUTOPILOT	F52A00	91	86	- 5	- 5.49	INSIGNIFICANT DIFFERENCE
UHF COMMUNICATION SET	F63A00	32	62	+ 30	+ 93.75	MUCH LOWER FAILURE RATE
IFF TRANSPONDER SET	F65A00	18	17	- 1	- 5.56	INSIGNIFICANT DIFFERENCE
INERTIAL NAV. SET	F71A00	26	18	- 8	- 30.77	SIGNIFICANTLY HIGHER FAILURE RATE
INSTRU. LANDING SET	F71C00	108	*	- - -	- - -	- - -
TACAN SET	F71D00	83	88	+ 5	+ 6.02	INSIGNIFICANT DIFFERENCE
ATTIT.-HEADING REF. SET	F71F00	117	157	+ 40	+ 34.19	SIGNIFICANTLY LOWER FAILURE RATE
RADAR SET	F74F00	9	9	0	0	NO DIFFERENCE
			AVERAGE DIFFERENCE	+ 1.17	- 1.79	

*OPERATING POINT FROM BITBURG IN INDETERMINATE REGION OF ESTIMATING MODEL.

Therefore, that portion of step 6 was not necessary for the initial experiments. The values for the regression variables were obtained from the F-15A/Bitburg entries in the Maintenance Metrics study data base. These transformed F-clocks were used according to the validation experiment plan of paragraph II.5.

The F-clock transformation procedure was then applied to all 30 aircraft subsystems studied for the LCOM simulations of the three selected KC-135A bases. The simulation model used for these experiments contained generic ASD standard F-clock values derived from a composite of five representative KC-135A bases; i.e., Altus, Blytheville, Grand Forks, Griffiss, and K. I. Sawyer (See reference 10). Therefore it was necessary to calculate sets of base-specific baseline F-clock values for the three study bases; Loring, Seymour-Johnson, and Castle. Sortie and failure data from the year 1977 were used for this purpose. The D056E, G033B, and KC-135A source data used for calculation of the baseline failure clocks and also for use in the F-clock transformation regression equations is included in this document as Appendix B. Appendix C contains the baseline F-clock calculation worksheets. These baseline F-clock values were then imposed on the existing generic ASD KC-135A model via appropriate clock change cards for the base-specific baseline simulation runs.

The thirty study equipment failure clocks were then transformed to the maintenance metrics values for the metrics validation experiments. Appendix D contains the completed worksheets for these transformations for each of the three study bases. The values for the regression variables in these worksheets were obtained from the subject base entries in the 1977 G033B, D056E, and Air Weather Service data bases for maintenance demand, operations, and environmental variables. KC-135A equipment design characteristic data were obtained from the Maintenance Metrics study data base. Table 2 contains a summary of the ASD standard, baseline, and metrics derived F-clock values for each of the study bases. The validation experiment plan based on these transformed F-clock values is given in paragraph II.7.

5. NEW METRICS AND WEIGHTINGS INITIAL VALIDATION EXPERIMENTS - SUBTASKS 8.4

An initial series of LCOM simulation experiments were performed to evaluate the F-clock estimation equations developed during study tasks VI and VII (refer to Boeing document D194-10089-3) for the Phase I study equipments (propulsion and avionics). These equations appear on the F-clock transformation worksheet in Appendix A.

The objective of these experiments was to determine how well the generalized F-clock estimating models, which were derived from an Air Force-wide population of aircraft and bases, could duplicate simulation results based on actual historical failures per sortie data from

TABLE 2 SUMMARY OF F-CLOCK VALUES TRANSFORMED
FOR KC-135A LCOM METRICS VALIDATION EXPERIMENTS

SYSTEM	F-CLOCK NUMBER I.D.	F-CLOCKS IN ASD KC-135A MODEL	F-CLOCKS LORING BASELINE	F-CLOCKS LORING METRICS	F-CLOCKS SEYMOUR-J BASELINE	F-CLOCKS SEYMOUR-J METRICS	F-CLOCKS CASTLE BASELINE	F-CLOCKS CASTLE METRICS
Propulsion	FA23AS	25.0	38.5	37.7	29.0	51.7	28.4	47.4
	FA23AO	567.0	789.5	773.7	782.0	1395.3	508.6	1016.4
	FA23BS	9.0	29.3	29.2	6.3	11.2	8.1	13.5
	FA23CS	103.0	17.5	17.2	11.7	20.3	18.5	31.[illegible]
	FA23DS	174.0	42.7	41.8	60.2	107.4	52.5	87.7
	FA23ES	10.4	32.2	31.6	10.4	18.5	9.2	15.4
	FA23HS	15.0	10.4	10.2	4.6	3.2	7.9	13.2
	FA23JS	9.0	5.1	5.0	2.7	4.3	4.7	7.3
	FA23JO	1134.0	789.5	773.7	391.0	697.6	508.6	1016.4
	FA23KS	4.0	6.1	6.0	3.7	6.2	6.[illegible]	10.2
	FA23LS	19.0	7.4	7.3	7.2	12.8	9.4	15.7
	FA23MS	7.0	6.4	6.3	5.2	9.3	[illegible]	6.2
	FA23NS	16.0	11.0	10.8	35.5	63.3	11.3	18.9
	FA23OS	39.0	225.6	221.1	10.6	18.9	50.7	84.7
	FA23PS	5.0	4.9	4.8	3.9	7.0	5.2	3.7
	FA23RS	13.0	8.3	8.1	5.7	10.2	7.0	11.7
	FA23RO	73.0	49.3	48.3	34.0	60.7	42.3	70.6
Flt. Indic.	FA511S	7.8	11.0	22.0	7.6	*12.2	7.6	* 2.6
Air Data	FA51BS	19.0	20.5	6.3	12.6	14.5	13.3	53.7
Horiz. Situa.	FA51AS	4.5	7.5	4.5	6.3	25.7	4.1	6.6
Autopilot	FA521S	18.0	27.2	20.1	41.2	19.6	26.2	43.0
	FA5210	5.3	9.1	6.7	13.5	6.4	3.3	14.4
UHF Comm.	FA63RS	87.0	4.4	*41.0	7.7	*51.3	7.8	*12.5
IFF Set	FA65BS	10.6	17.2	30.4	11.3	28.6	15.3	86.8
Inst. Lndg.	FA71BS	13.6	21.6	9.7	41.2	25.7	27.4	14.5
Tacan	FA71CS	5.7	7.4	16.6	6.0	39.5	10.3	3.3
Radar	FA72BS	1.8	2.3	2.5	2.2	1.5	2.9	9.7
Fuselage	FA111S	450.0	4.2	0.9	6.7	9.8	7.3	3.1
Wings	FA11AO	18.0	21.1	15.6	17.0	49.5	18.8	16.2
	FA11JO	7.0	7.7	5.7	3.1	9.0	8.9	7.7
	FA11KO	7.3	8.0	5.9	2.8	8.2	11.9	10.2
	FA116S	99.0	131.6	97.4	130.3	379.7	86.9	74.7
	FA1160	44.0	65.8	48.7	71.1	207.2	43.5	37.4
	FA117S	103.0	121.5	89.9	156.4	455.8	144.9	124.6
	FA1170	37.0	41.6	30.8	55.9	162.9	48.3	41.5
Cockpit Furnishings	FA12AS	67.0	83.1	* 75.6	71.1	201.4	138.3	*120.0
	FA12AO	142.0	157.9	143.7	156.4	443.1	276.6	240.0
Lndg. Gear	FA13AO	8.5	3.0	1.9	3.3	3.0	2.5	4.3
Brakes	FA13CS	3.0	4.7	*22.4	10.7	16.8	5.4	36.9
Stabilator	FA11GO	27.0	23.6	17.0	60.2	14.0	53.4	19.2
Rudder	FA1480	69.0	8.9	* 9.6	24.4	* 3.7	14.2	* 5.3
Flaps	FA14EO	11.0	3.0	* 2.2	4.8	* 5.0	6.0	*15.7
Environ. Control	FA412S	18.6	38.5	*55.0	32.6	*186.0	31.1	*44.4
	FA4120	26.0	56.4	80.7	48.9	279.2	46.1	65.9
Elect. Pwr.	FA421S	38.0	4.4	12.8	2.8	10.3	4.2	12.9
Hydr. Pwr.	FA451S	3.0	3.2	* 4.5	5.6	* 6.0	3.7	*19.0
Internal Fuel	FA461S	12.0	12.0	*49.1	31.3	55.2	14.6	*833.1
	FA4620	13.0	10.7	43.8	39.1	68.9	12.7	724.6
	FA4630	23.0	22.6	92.5	71.1	125.3	17.6	1004.2
Lox Syst.	FA471S	10.0	13.4	24.9	11.3	*45.8	14.4	*50.9
Fire Detect.	FA494S	16.3	12.7	*187.6	11.3	*450.9	7.3	*757.4

*From other than composite model (see Appendix D) a specific aircraft (F-15A), a specific base (Bitburg), and a specific time period (1977). This determination is a measure of the confidence that can be placed in the estimating equations when used in a new situation or for an emerging weapon system. The determination was made by exercising the F-15A/Bitburg LCOM simulation with the new F-clock values singly and in combination. The results of these simulations were then compared to baseline model runs as discussed in paragraph II.6. This initial series of experimental simulation runs to validate the Phase I F-clock estimation equations is listed in Table 3. The relationships of these initial validation experiments are shown in the simulation plan shown in Figure 5. The simulation experiments were performed at the ASD Computer Center, Wright-Patterson Air Force Base, Ohio, on the ITEL Computer System.

6. DIFFERENCE ANALYSIS - BASELINE VERSUS MODIFIED F-15A MODEL RESULTS (NEW METRICS) - SUBTASK 8.5

At the conclusion of the initial Phase I validation experiments, a difference analysis was performed which compared the results of the baseline simulation with the various experimental runs as listed in Table 3. This analysis determined how well the F-clock values based on estimated data could duplicate simulation results from F-clock values based on actual historical data. The analysis compared twenty-five critical output variables of the baseline run against the same outputs of the various experimental runs. Table 4 lists the critical output variables monitored.

In the initial series of Phase I validation runs, it was found that the new F-clock estimating equations developed for the eleven avionic systems were able to duplicate actual historical results within approximately plus or minus 10 percent. It is therefore considered that these estimators can be used for predicting F-clock values in new situations with a high degree of confidence.

The F-clock estimating equation for the propulsion system yielded significant deviations in simulation results compared to the baseline run. Therefore, it was considered that this estimating equation required modification and/or refinement before it can be used with confidence.

Table 5 summarizes the findings of the difference analysis of the initial series of Phase I validation experiments.

7. NEW METRICS AND WEIGHTINGS SUBSEQUENT VALIDATION EXPERIMENTS - SUBTASK 8.4

Three subsequent series of LCOM simulation experiments were performed to evaluate the thirty F-clock estimation equations developed during study tasks VI and VII (refer to Boeing document D194-10089-3).

TABLE 3

EXPERIMENTAL LCOM RUNS (F-15A, BITBURG)

BASELINE RUN:	F-CLOCK VALUES BASED ON HISTORICAL FAILURES/SORTIE (1977 BITBURG DATA).
EXPERIMENT 1:	ALL PHASE I STUDY EQUIPMENT F-CLOCKS CHANGED PER METRICS MODELS.
EXPERIMENT 2:	LARGE DIFFERENCE (METRICS MODEL TO BASELINE) F-CLOCKS CHANGED (F23000, F27000, F51A00, F63A00, F71A00, F71F00).
EXPERIMENT 3:	ENGINE F-CLOCKS ONLY CHANGED PER METRICS MODEL (F23000, F27000)
EXPERIMENT 4:	ALL AVIONICS F-CLOCKS CHANGED PER METRICS MODELS (F51A00, F51E00, F51H00, F52A00, F63A00, F65A00, F71A00, F71C00, F71D00, F71F00, F74F00).
EXPERIMENT 5:	ENGINE #1 F-CLOCK ONLY CHANGED (F23000).
EXPERIMENT 6:	FLIGHT INDICATORS F-CLOCK ONLY CHANGED (F51A00).
EXPERIMENT 7:	UHF F-CLOCK ONLY CHANGED (F63A00).
EXPERIMENT 8:	ATTITUDE-HEADING REF. F-CLOCK ONLY CHANGED (F71F00).
EXPERIMENT 9:	INERTIAL NAVIGATION F-CLOCK ONLY CHANGED (F71A00).
EXPERIMENT 10:	AIR DATA SYSTEM F-CLOCK ONLY CHANGED (F51E00).
EXPERIMENT 11:	HORIZONTAL SITUATION INDICATOR F-CLOCK ONLY CHANGED (F51H00).
EXPERIMENT 12:	AUTOPILOT ONLY F-CLOCK ONLY CHANGED (F52A00).
EXPERIMENT 13:	TACAN F-CLOCK ONLY CHANGED (F71D00).
EXPERIMENT 14:	IFF TRANSPONDER F-CLOCK ONLY CHANGED (F65A00).

INITIAL SERIES--ASD/MCDONNELL DOUGLAS LCOM SIMULATION
OF F-15A/BITBURG (1977 DATA BASE)

- SERIES 1 BASELINE RUN (1977 DATA, 20 HR. FLYING PROGRAM) F-CLOCKS BASED ON 1977 HISTORICAL FAILURES/SORTIE.
  - SERIES 1 VALIDATION EXPERIMENTS. F-CLOCKS OF NETWORKS TESTED ARE BASED ON METRICS MODELS WITH 1977 BITBURG OPERATING POINT.
    - EXPERIMENT 1: ALL AVIONICS AND PROPULSION NETWORKS TESTED.
      - EXPERIMENT 2: LARGE DIFFERENCE (METRICS TO BASELINE F-CLOCK VALUES) NETWORKS TESTED.
        - EXPERIMENT 3: ENGINE NETWORKS #1 AND #2 tested.
        - EXPERIMENT 4: ALL AVIONICS NETWORKS TESTED.
          - EXPERIMENT 5: ENGINE #1 NETWORK METRIC TESTED SINGLY.
          - EXPERIMENT 6: FLIGHT INDICATOR F-CLOCK METRIC TESTED.
          - EXPERIMENT 7: UHF SET F-CLOCK METRIC TESTED.
          - EXPERIMENT 8: ATTITUDE-HEADING REF. SET F-CLOCK METRIC TESTED.
          - EXPERIMENT 9: INERTIAL NAV SET F-CLOCK METRIC TESTED.
          - EXPERIMENT 10: AIR DATA SYSTEM F-CLOCK METRIC TESTED.
          - EXPERIMENT 11: HORIZONTAL SITUATION INDIC. F-CLOCK METRIC TESTED.
          - EXPERIMENT 12: AUTOPILOT F-CLOCK METRIC TESTED.
          - EXPERIMENT 13: TACAN SET F-CLOCK METRIC TESTED.
          - EXPERIMENT 14: IFF TRANSPONDER SET F-CLOCK METRIC TESTED.

FIGURE 5 TASK VIII - INITIAL VALIDATION EXPERIMENTS SIMULATION PLAN

TABLE 4

CRITICAL OUTPUT VARIABLES MONITORED

1. PERCENT SORTIES ACCOMPLISHED
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS.
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)
10. FLYING HOURS ACCOMPLISHED
11. PERCENT AVAILABLE MANHOURS UTILIZED
12. ACTUAL MANHOURS USED
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE
15. MAINTENANCE MANHOURS PER FLYING HOUR
16. NUMBER OF REPARABLE GENERATIONS
17. PERCENT BASE REPAIR
18. PERCENT DEPOT REPAIR
19. AVERAGE BASE REPAIR CYCLE
20. PERCENT ACTIVE REPAIR
21. PERCENT WHITE SPACE

22. NUMBER OF ITEMS BACKLOGGED
23. NUMBER OF UNITS DEMANDED
24. PERCENT OF DEMANDS NOT SATISFIED
25. NUMBER OF ITEMS ON BACKORDER

TABLE 5-1

SERIES 1 DIFFERENCE ANALYSIS SUMMARY

EXPERIMENT 1: ALL PHASE I EQUIPMENT F-CLOCKS CHANGED

FINDINGS:

- AVERAGE PERCENT DIFFERENCE OF 25 CRITICAL VARIABLES FROM BASELINE VALUES = 52.24%
- 18 VARIABLES MONITORED HAD LESS THAN 25% DIFFERENCE (1, 2, 3, 4, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 23)
- 7 VARIABLES MONITORED HAD MORE THAN 50% DIFFERENCE (5, 7, 9, 19, 21, 24, 25)

CONCLUSION: SUPPLY PORTION OF SIMULATION SENSITIVE TO F-CLOCK CHANGES. SUPPLY CHANNELS AND SPARE STOCKAGE APPEAR TO BE OVERLOADED BY ONE OR MORE OF THE NEW CLOCK VALUES.

EXPERIMENT 2: HIGH DRIVER EQUIPMENT F-CLOCKS CHANGES

FINDINGS:

- AVERAGE PERCENT DIFFERENCE OF 25 CRITICAL VARIABLES FROM BASELINE VALUES = 47.33%
- 18 VARIABLES MONITORED HAD LESS THAN 25% DIFFERENCE (1, 2, 3, 4, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 23)
- 2 VARIABLES HAD LESS THAN 50% DIFFERENCE (19, 21)
- 5 VARIABLES HAD MORE THAN 50% DIFFERENCE (5, 7, 9, 24, 25)

CONCLUSION: SAME AS EXPERIMENT 1.

TABLE 5-2

SERIES 1 DIFFERENCE ANALYSIS SUMMARY (CONTINUED)

EXPERIMENT 3: ENGINE F-CLOCKS ONLY CHANGED

FINDINGS:

- AVERAGE PERCENT DIFFERENCE OF 25 CRITICAL VARIABLES FROM BASELINE VALUES = 61.83%
- 17 VARIABLES HAD LESS THAN 25% DIFFERENCE (1, 2, 3, 4, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 23)
- 1 VARIABLE HAD LESS THAN 50% DIFFERENCE (19)
- 7 VARIABLES HAD MORE THAN 50% DIFFERENCE (5, 7, 9, 21, 22, 24, 25)

CONCLUSION: SUPPLY PORTION OF SIMULATION APPEARS TO BE HIGHLY SENSITIVE TO ENGINE F-CLOCKS. HIGHER ENGINE FAILURES RATES SET BY METRICS MODEL APPEARS TO HAVE OVERLOADED ENGINE SPARES RESOURCE.

EXPERIMENT 4: ALL AVIONICS F-CLOCKS CHANGED

FINDINGS:

- AVERAGE PERCENT DIFFERENCE OF 25 CRITICAL VARIABLES FROM BASELINE VALUES = 8.25%
- 22 VARIABLES HAD LESS THAN 25% DIFFERENCE (1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23)
- 1 VARIABLE HAD LESS THAN 50% DIFFERENCE (25)
- 2 VARIABLES HAD MORE THAN 50% DIFFERENCE (5,24)

CONCLUSION: THE AVIONIC F-CLOCK METRICS MODELS APPEAR TO HAVE PROVIDED A SIMULATION OF ACTUAL CONDITIONS WHICH IS WITHIN ACCEPTABLE SENSITIVITY LIMITS OF THE LCOM SIMULATION SINCE THE OVERALL EFFECTS OF THE AVIONIC CLOCK CHANGES WERE OF LOW SIGNIFICANCE TO THE FINAL SIMULATED PERFORMANCE VALUES. VARIABLES CONCERNED WITH SUPPLY RESOURCES APPEARED MOST SENSITIVE TO F-CLOCK CHANGES.

TABLE 5-3

SERIES 1 DIFFERENCE ANALYSIS SUMMARY (CONTINUED)

EXPERIMENTS 5 THROUGH 14: PHASE I EQUIPMENT F-CLOCKS CHANGED ONE AT A TIME

FINDINGS:

- AVERAGE PERCENT DIFFERENCE OF 25 CRITICAL VARIABLES FROM BASELINE VALUES = 4.18%
- 21 VARIABLES MONITORED HAD LESS THAN 25% DIFFERENCE (1, 2, 3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23)
- 2 VARIABLES HAD LESS THAN 50% DIFFERENCE (24, 25)
- 2 VARIABLES HAD MORE THAN 50% DIFFERENCE (5, 7)

CONCLUSION: NONE OF THE SINGLE CLOCKS TESTED APPEARED TO HAVE A SIGNIFICANT EFFECT ON THE OVERALL SENSITIVITY OF THE SIMULATION. VARIABLES CONCERNED WITH SUPPLY RESOURCES AGAIN APPEARED MOST SENSITIVE TO F-CLOCK CHANGES.

IMPLICATIONS OF DIFFERENCE ANALYSIS

- FURTHER REFINEMENT OF PROPULSION METRICS MODEL APPEARS WARRANTED.
- SEVERAL REPEAT SIMULATIONS SHOULD BE RUN TO ESTABLISH THE NATURAL VARIANCE OF THE OUTPUT VALUES UNDER VARYING INPUT CONDITIONS.

These experiments were designed to test the new metrics equations within the context of an aircraft type (cargo-tanker) and subsystem assemblage which was quite different than the baseline aircraft subsystem configuration around which the equations were originally developed, i.e., the F-15A fighter-interceptor. Also, the experiments pertained to Air Force base simulations (Loring, Seymour-Johnson, and Castle) which were not included in the original study data base. Application to these bases forms a significant check on the applicability of the equations to new basing situations and gives indication of the relevant range of the derived F-clock estimation models. The thirty subject equations are listed by subsystem in Table D1, Appendix D, with Loring AFB operating point values for the included variables. Table D2 lists the equations with Seymour-Johnson AFB values, and Table D3 lists the equations with Castle AFB values. The F-clock values for each base resulting from the computations of Tables D1, D2, and D3 are summarized in Table 2, paragraph II.4.

As in the initial series of experiments, the objective of these simulations was to determine the expected accuracy and confidence level to be placed on estimates computed from the new metrics models when used in a new situation or for an emerging weapon system. The validation experiments were planned to exercise the KC-135A/Loring, Seymour-Johnson, and Castle LCOM simulations with the new F-clock values to test the sensitivity of the simulation results to the metrics inputs. The results of these simulations were then compared to baseline model runs and to actual historical 1977 performance data from the subject bases as discussed in paragraph II.8. The series of planned experimental simulation runs and their relationships for the KC-135A/Loring LCOM are depicted in Figure 6. Similar simulation plans for the KC-135A/Seymour-Johnson LCOM and the KC-135A/Castle LCOM are depicted in Figures 7 and 8. Three simulation runs, each using a different clock control random number seed, were executed for each set of standard, baseline, and metrics validation runs. The code names of these runs are shown on the simulation plans (Figures 6, 7, and 8). The three runs for each set were necessary to average out random deviations in the simulation outputs and allow a more accurate comparison of results. The depicted plans are meant to be progressive depending upon the results obtained from the initial experiments in the series. For instance, if the results of experiment 1 of simulation series 2 (refer to Figure 6), where all 30 F-clocks are modified and tested together, indicate no significant deviations from the historic performance data to be used for comparison, further experimentation would not be required. If, however, significant deviation was detected, then further experimentation according to the plan would be required to identify the particular F-clocks causing the deviation. As in the initial series, the experiments in these subsequent series were performed at the ASD Computer Center, Wright-Patterson AFB.

MODEL USED--ASD STANDARD LCOM SIMULATION OF KC-135A/LORING AFB
SEYMOUR JOHNSON AFB/CASTLE AFB (1977 DATA BASE)

SERIES 2 COMPARISON RUNS

STANDARD RUNS- LORING AFB (1977 DATA, 7,481 HR. FLYING PROGRAM)
F-CLOCKS SET AT STANDARD KC-135A VALUES. (LSEED1, LSEED2, LSEED3)

BASELINE RUNS- F-CLOCKS SET AT LORING BASELINE VALUES.
(LSEED7, LSEED8, LSEED9)

SERIES 2 VALIDATION EXPERIMENTS. KC-135A/LORING AFB 1977 OPERATING POINT. F-CLOCKS OF NETWORKS TESTED OBTAINED FROM METRICS MODELS.

EXPERIMENT 1: ALL 30 STUDY NETWORKS TESTED.
(LSEED4, LSEED5, LSEED6)

OPTIONAL FOLLOW-ON EXPERIMENTS

EXPERIMENT 2: LARGE DIFFERENCE (METRICS TO STANDARD F-CLOCK VALUES) NETWORKS TESTED.

EXPERIMENT 3: AVIONICS NETWORKS TESTED.

EXPERIMENT 4: PROPULSION NETWORKS TESTED.

EXPERIMENT 5: AIRFRAME NETWORKS TESTED.

EXPERIMENT 6: FLIGHT CONTROL SYSTEMS NETWORKS TESTED.

EXPERIMENT 7: UTILITY SYSTEMS NETWORKS TESTED.

FIGURE 6 TASK VIII - KC-135A/LORING AFB
VALIDATION EXPERIMENTS SIMULATION PLAN

MODEL USED--ASD STANDARD LCOM SIMULATION OF KC-135A/LORING AFB
SEYMOUR JOHNSON AFB/CASTLE AFB (1977 DATA BASE)

SERIES 3 COMPARISON RUNS

STANDARD RUNS- SEYMOUR JOHNSON AFB (1977 DATA, 3,778 HR. FLYING PROGRAM). F-CLOSKS SET AT STANDARD KC-135A VALUES.(SSEED1, SSEED2, SSEED3)

BASELINE RUNS- F-CLOCKS SET AT SEYMOUR-JOHNSON BASELINE VALUES. (SSEED7, SSEED8, SSEED9)

SERIES 3 VALIDATION EXPERIMENTS. KC-135A/SEYMOUR JOHNSON AFB 1977 OPERATING POINT. F-CLOCKS OF NETWORKS TESTED OBTAINED FROM METRICS MODELS.

EXPERIMENT 1: ALL 30 STUDY NETWORKS TESTED.
(SSEED4, SSEED5, SSEED6)

EXPERIMENT 2: LARGE DIFFERENCE (METRICS TO STANDARD F-CLOCK VALUES) NETWORKS TESTED.

OPTIONAL FOLLOW-ON EXPERIMENTS

EXPERIMENT 3: AVIONICS NETWORKS TESTED.

EXPERIMENT 4: PROPULSION NETWORKS TESTED.

EXPERIMENT 5: AIRFRAME NETWORKS TESTED.

EXPERIMENT 6: FLIGHT CONTROL SYSTEMS NETWORKS TESTED.

EXPERIMENT 7: UTILITY SYSTEMS NETWORKS TESTED.

FIGURE 7 TASK VIII - KC-135A/SEYMOUR JOHNSON AFB
VALIDATION EXPERIMENTS SIMULATION PLAN

MODEL USED--ASD STANDARD LCOM SIMULATION OF KC-135A/LORING AFB
SEYMOUR JOHNSON AFB/CASTLE AFB (1977 DATA BASE)

SERIES 4 COMPARISON RUNS
STANDARD RUNS- CASTLE AFB (1977 DATA, 18,372 HR. FLYING PROGRAM)
F-CLOCKS SET AT STANDARD KC-135A VALUES.(CSEED1, CSEED2, CSEED3)
BASELINE RUNS- F-CLOCKS SET AT CASTLE BASELINE VALUES.
(CSEED7, CSEED8, CSEED9)

SERIES 4 VALIDATION EXPERIMENTS. KC-135A/CASTLE AFB 1977 OPERATING POINT. F-CLOCKS OF NETWORKS TESTED OBTAINED FROM METRICS MODELS.

EXPERIMENT 1: ALL 30 STUDY NETWORKS TESTED.
(CSEED4, CSEED5, CSEED6)

OPTIONAL FOLLOW-ON EXPERIMENTS

EXPERIMENT 2: LARGE DIFFERENCE (METRICS TO STANDARD F-CLOCK VALUES) NETWORKS TESTED.

EXPERIMENT 3: AVIONICS NETWORKS TESTED.

EXPERIMENT 4: PROPULSION NETWORKS TESTED.

EXPERIMENT 5: AIRFRAME NETWORKS TESTED.

EXPERIMENT 6: FLIGHT CONTROL SYSTEMS NETWORKS TESTED.

EXPERIMENT 7: UTILITY SYSTEMS NETWORKS TESTED.

FIGURE 8 TASK VIII - KC-135A/CASTLE AFB VALIDATION EXPERIMENTS SIMULATION PLAN

8. DIFFERENCE ANALYSIS - BASELINE VERSUS MODIFIED KC-135A MODEL RESULTS (NEW METRICS) - SUBTASK 8.5

As the series 2, 3, and 4 validation experiments were performed, difference analyses were performed which compared the results of the baseline simulations of the three subject bases, Loring, Seymour-Johnson, and Castle with the various experimental runs as depicted in Figures 6, 7, and 8. These simulation results were also compared with actual historical squadron performance data from the 1977 time period simulated. These analyses indicated how well the F-clock values based on estimated metrics data could simulate the actual historic situation as compared to the current standard F-clock values used in the baseline simulations. The analyses compared 25 critical output variables (see Table 4, paragraph II.6) of the baseline runs against the same outputs of the various experimental and standard runs. Selected operational and maintenance (O&M) critical output variables from the baseline runs were then compared against actual 1977 values from the historic data files from the subject bases in the G033B and D056E Air Force data systems. Figure 9 depicts the relationships of the comparisons made. Tables 6, 7, and 8 present the numerical results of the difference analyses depicted by Figure 9 for having Seymour-Johnson, and Castle AFB's respectively. Summary findings of these difference analyses are presented in Tables 9, 10, and 11. Comparisons of each base's baseline simulation output to 1977 actual data are given in Tables 12, 13, and 14.

The general procedure used in the comparative analyses depicted in Figure 9 was as follows:

(1) Record the critical variable outputs for each set of three random-number-seed runs for standard, metrics, and baseline F-clock simulations. These data are recorded in Appendix E.

(2) Average the outputs for each set of three seeds for the standard, metrics, and baseline run sets. These averages are the values used in the difference analyses recorded in Tables 6, 7, and 8.

(3) Compare difference in critical outputs between the standard, metrics, and baseline runs for each base. Tables 6, 7, and 8 show these differences for Loring, Seymour-Johnson, and Castle Air Force Bases respectively.

(4) Summarize and interpret the findings of the difference analyses for each base. These summaries for Loring, Seymour-Johnson, and Castle AFB's appear as Tables 9, 10, and 11.

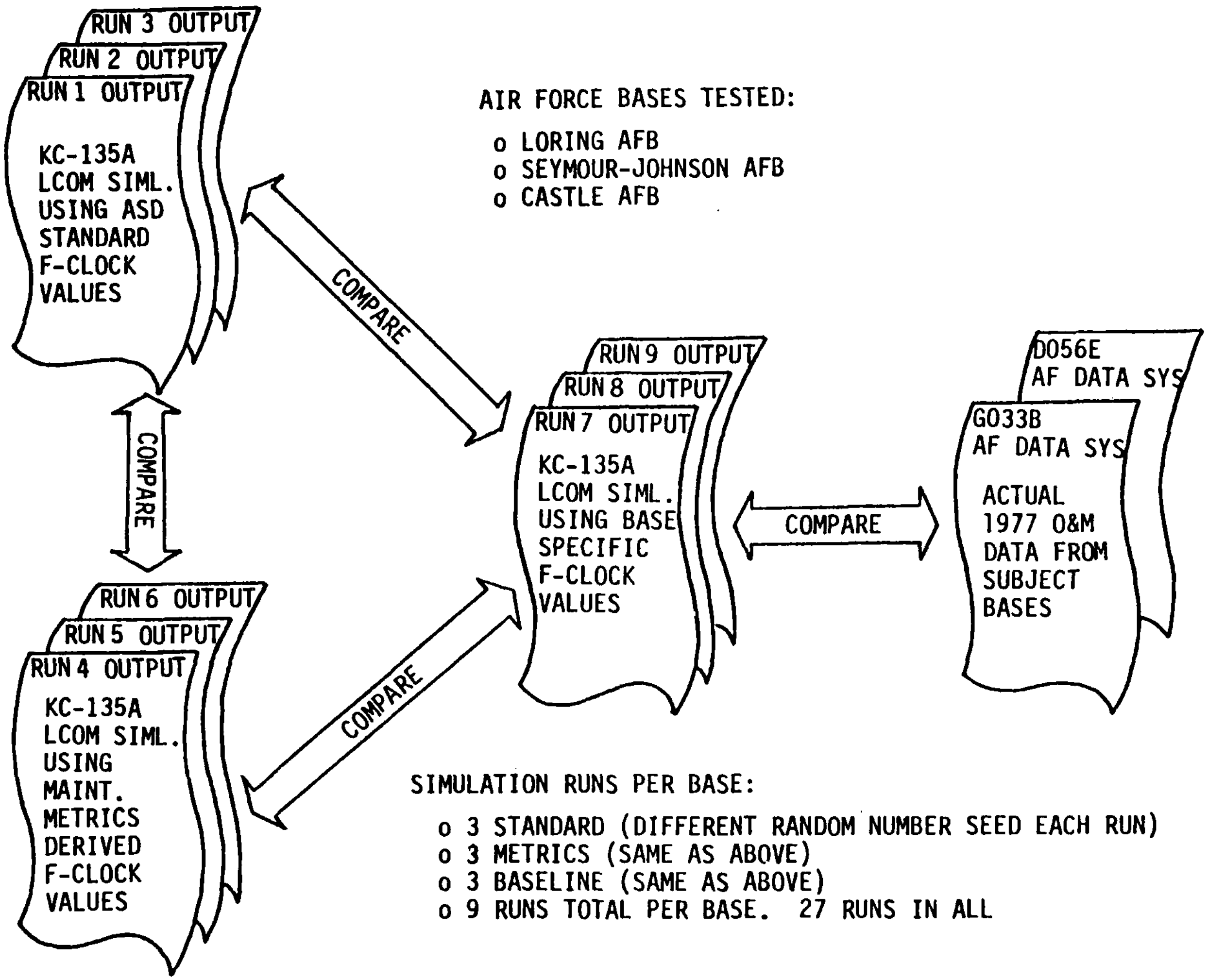

FIGURE 9 RELATIONSHIPS AND PROCEDURE FOR KC-135A METRICS VALIDATION COMPARATIVE ANALYSIS

TABLE 6 DIFFERENCE ANALYSIS FOR LCOM VALIDATION EXPERIMENTS, 1977 DATA - LORING AFB, KC-135A

CRITICAL OUTPUT VARIABLES MONITORED	3-RUN AVG. RESULTS FROM ASD STD, METRICS, AND 1977 BASELINE F-CLOCK VALUES								
	ASD STD. AVG.	ASD/BASELINE		ASD/METRICS		METRICS AVG.	METRICS/BASELINE		1977 BASE-LINE AVG.
		Δ	% DIFF.	Δ	% DIFF.		Δ	% DIFF.	
	112 Days Siml.					112 Days Siml.			112 Days Siml.
1. PERCENT SORTIES ACCOMPLISHED	71.94	- 5.87	- 5.87	- 4.97	- 4.97	76.91	- 0.90	- 0.90	77.81
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	2.48	+ 0.47	+ 0.47	+ 0.50	+ 0.50	1.98	- 0.03	- 0.03	2.01
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCH. MAINTENANCE	2.78	+ 0.63	+ 0.63	+ 0.68	+ 0.68	2.10	- 0.05	- 0.05	2.15
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCH. MAINTENANCE	3.58	+ 0.84	+ 0.84	+ 0.93	+ 0.93	2.65	- 0.09	- 0.09	2.74
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	5.27	- 3.86	- 3.86	+ 0.27	+ 0.27	5.00	- 4.13	- 4.13	9.13
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.08	+ 0.02	+ 0.02	+ 0.02	+ 0.02	0.06	0	0	0.06
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE & WAITING	4.32	+ 1.03	+ 1.03	+ 1.00	+ 1.00	3.32	+ 0.03	+ 0.03	3.29
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	81.51	+ 0.88	+ 0.88	- 3.37	- 3.37	84.88	+ 4.25	+ 4.25	80.63
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.77	+ 0.14	+ 3.02	+ 0.11	+ 2.36	4.66	+ 0.03	+ 0.65	4.63
10. FLYING HOURS ACCOMPLISHED	2340.68	-127.95	- 5.18	-95.76	- 3.93	2436.44	-32.19	- 1.30	2468.63
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.55	- 0.04	- 0.04	0	0	2.55	- 0.04	- 0.04	2.59
12. ACTUAL MANHOURS USED (100's)	304.70	- 3.77	- 1.22	+ 0.19	+ 0.06	304.51	- 3.96	- 1.28	308.47
13. PERCENT MAINTENANCE MANHOURS IN UNSCH. MAINTENANCE	45.57	+ 0.47	+ 0.47	+ 0.52	+ 0.52	45.05	- 0.05	- 0.05	45.10
14. PERCENT MAINTENANCE MANHOURS IN SCH. MAINTENANCE	54.43	- 0.47	- 0.47	- 0.52	- 0.52	54.95	+ 0.05	+ 0.05	54.90
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.10	+ 0.59	+ 4.72	+ 0.60	+ 4.80	12.50	- 0.01	- 0.08	12.51
16. NUMBER OF REPARABLE GENERATIONS	1791.00	-103.00	- 5.44	-28.00	- 1.54	1819.00	-75.00	- 3.96	1894.00
17. PERCENT BASE REPAIR	58.31	+ 0.53	+ 0.53	- 4.27	- 4.27	62.58	+ 4.80	+ 4.80	57.78
18. PERCENT DEPOT REPAIR	41.69	- 0.53	- 0.53	+ 4.27	+ 4.27	37.42	- 4.80	- 4.80	42.22
19. AVERAGE BASE REPAIR CYCLE	3.41	- 0.08	- 2.29	- 0.12	- 3.40	3.53	+ 0.04	+ 1.15	3.49
20. PERCENT ACTIVE REPAIR	75.27	- 1.87	- 1.87	- 3.00	- 3.00	78.27	+ 1.13	+ 1.13	77.14
21. PERCENT WHITE SPACE	24.73	+ 1.87	+ 1.87	+ 3.00	+ 3.00	21.73	- 1.13	- 1.13	22.86
22. NUMBER OF ITEMS BACKLOGGED	205.00	+ 53.00	+34.87	+29.00	+ 16.48	176.00	+24.00	+15.79	152.00
23. NUMBER OF UNITS DEMANDED	1630.00	- 87.00	- 5.07	-17.00	- 1.03	1647.00	-70.00	- 4.08	1717.00
24. PERCENT OF DEMANDS NOT SATISFIED	5.37	- 2.20	- 2.20	- 0.67	- 0.67	6.04	- 1.53	- 1.53	7.57
25. NUMBER OF ITEMS ON BACKORDER	1.00	- 3.00	-75.00	0	0	1.00	- 3.00	-75.00	4.00

TABLE 7 DIFFERENCE ANALYSIS FOR LCOM VALIDATION EXPERIMENTS, 1977 DATA - SEYMOUR-JOHNSON AFB, KC-135A

CRITICAL OUTPUT VARIABLES MONITORED	3-RUN AVG. RESULTS FROM ASD STD, METRICS, AND 1977 BASELINE F-CLOCK VALUES								
	ASD STD. AVG.	ASD/BASELINE		ASD/METRICS		METRICS AVG.	METRICS/BASELINE		1977 BASE-LINE AVG.
		Δ	% DIFF.	Δ	% DIFF.		Δ	% DIFF.	
	112 Days Siml.					112 Days Siml.			112 Days Siml.
1. PERCENT SORTIES ACCOMPLISHED	77.25	+ 1.07	+ 1.07	+ 0.50	+ 0.50	76.75	+ 0.57	+ 0.57	76.18
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.77	- 0.09	- 0.09	- 0.09	- 0.09	1.86	0	0	1.86
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCH. MAINTENANCE	2.05	- 0.10	- 0.10	+ 0.11	+ 0.11	1.94	- 0.19	- 0.19	2.15
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCH. MAINTENANCE	2.58	+ 0.02	+ 0.02	- 0.10	- 0.10	2.68	+ 0.12	+ 0.12	2.56
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	6.24	- 3.19	- 3.19	+ 2.00	+ 2.00	4.24	- 5.19	- 5.19	9.43
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.07	0		+ 0.01	+ 0.01	0.06	- 0.01	- 0.01	0.07
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE & WAITING	3.25	+ 0.21	+ 0.21	+ 0.51	+ 0.51	2.74	- 0.30	- 0.30	3.04
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	84.04	+ 3.16	+ 3.16	- 2.44	- 2.44	86.46	+ 5.58	+ 5.58	80.88
9. *AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)*	5.33	+ 1.08	+ 25.41	+ 0.44	+ 9.00	4.89	+ 0.64	+15.06	4.25
10. FLYING HOURS ACCOMPLISHED	2219.90	-103.73	- 4.46	-103.06	- 4.44	2322.96	- 0.67	- 0.03	2323.63
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.56	- 0.21	- 0.21	+ 0.07	+ 0.07	2.49	- 0.28	- 0.28	2.77
12. *ACTUAL MANHOURS USED (100's)*	305.08	- 26.31	- 7.94	+ 8.03	+ 2.70	297.05	- 34.34	-10.36	331.39
13. PERCENT MAINTENANCE MANHOURS IN UNSCH. MAINTENANCE	46.63	- 5.03	- 5.03	+ 0.65	+ 0.65	45.98	- 5.68	- 5.68	51.66
14. PERCENT MAINTENANCE MANHOURS IN SCH. MAINTENANCE	53.37	+ 5.03	+ 5.03	- 0.65	- 0.65	54.02	+ 5.68	+ 5.68	48.34
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.75	- 0.52	- 3.64	+ 0.94	+ 7.34	12.81	- 1.46	-10.23	14.27
16. NUMBER OF REPARABLE GENERATIONS	1953.00	-587.00	- 23.11	+ 55.00	+ 2.90	1898.00	-642.00	-24.57	2540.00
17. PERCENT BASE REPAIR	56.12	+ 5.65	+ 5.65	- 2.61	- 2.61	58.73	+ 8.26	+ 8.26	50.47
18. PERCENT DEPOT REPAIR	43.88	- 5.65	- 5.65	+ 2.61	+ 2.61	41.27	- 8.26	- 8.26	49.53
19. AVERAGE BASE REPAIR CYCLE	3.55	- 0.43	- 10.80	+ 0.01	+ 0.28	3.54	- 0.44	-11.06	3.98
20. PERCENT ACTIVE REPAIR	78.20	+ 0.80	+ 0.80	+ 2.42	+ 2.42	75.78	- 1.62	- 1.62	77.40
21. PERCENT WHITE SPACE	21.80	- 0.80	- 0.80	- 2.42	- 2.42	24.22	+ 1.62	+ 1.62	22.60
22. NUMBER OF ITEMS BACKLOGGED	224.00	-223.00	- 49.89	- 16.00	- 6.67	240.00	-207.00	-46.31	447.00
23. NUMBER OF UNITS DEMANDED	1787.00	-595.00	- 24.98	+ 55.00	+ 3.18	1732.00	-650.00	-27.29	2382.00
24. PERCENT OF DEMANDS NOT SATISFIED	10.51	- 16.61	- 16.61	- 16.61	-16.61	6.44	- 20.68	-20.68	27.12
25. NUMBER OF ITEMS ON BACKORDER	13.00	-138.00	- 91.39	- 5.00	-27.78	18.00	-133.00	-88.08	151.00

TABLE 8 DIFFERENCE ANALYSIS FOR LCOM VALIDATION EXPERIMENTS, 1977 DATA - CASTLE AFB, KC-135A

CRITICAL OUTPUT VARIABLES MONITORED	3-RUN AVG. RESULTS FROM ASD STD, METRICS, AND 1977 BASELINE F-CLOCK VALUES								
	ASD STD. AVG.	ASD/BASELINE		ASD/METRICS		METRICS AVG.	METRICS/BASELINE		1977 BASE-LINE AVG.
		Δ	% DIFF.	Δ	% DIFF.		Δ	% DIFF.	
	112 Days Siml.					112 Days Siml.			112 Days Siml.
1. PERCENT SORTIES ACCOMPLISHED	76.05	+ 1.27	+ 1.27	- 3.14	+ 3.14	72.91	- 1.87	- 1.87	74.78
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	2.84	- 0.22	- 0.22	+ 0.16	+ 0.16	2.68	- 0.38	- 0.38	3.06
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCH. MAINTENANCE	3.27	- 0.01	- 0.01	- 0.57	- 0.57	2.84	- 0.44	- 0.44	3.28
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCH. MAINTENANCE	3.66	- 0.31	- 0.31	- 0.01	- 0.01	3.67	- 0.30	- 0.30	3.97
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	14.04	- 0.20	- 0.20	- 3.36	- 3.36	17.40	+ 3.16	+ 3.16	14.24
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.07	- 0.01	- 0.01	0	0	0.07	- 0.01	- 0.01	0.08
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE & WAITING	5.69	+ 0.42	+ 0.42	+ 0.78	+ 0.78	4.91	- 0.36	- 0.36	5.27
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	72.21	+ 2.11	+ 2.11	+ 3.77	+ 3.77	68.44	- 1.66	- 1.66	70.10
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	6.53	- 0.23	- 3.40	- 0.58	- 8.16	7.11	+ 0.35	+ 5.18	6.76
10. FLYING HOURS ACCOMPLISHED	3514.45	-240.13	- 6.40	+234.05	+ 7.13	3280.40	-474.18	- 12.63	3754.58
11. PERCENT AVAILABLE MANHOURS UTILIZED	3.64	+ 0.15	+ 0.15	+ 0.46	+ 0.46	3.18	- 0.31	- 0.31	3.49
12. ACTUAL MANHOURS USED (100's)	434.18	+ 17.85	+ 4.29	+ 54.26	+ 14.28	379.92	- 36.41	- 8.75	416.33
13. PERCENT MAINTENANCE MANHOURS IN UNSCH. MAINTENANCE	50.93	+ 1.50	+ 1.50	+ 5.60	+ 5.60	45.33	- 4.10	- 4.10	49.43
14. PERCENT MAINTENANCE MANHOURS IN SCH. MAINTENANCE	49.07	- 1.50	- 1.50	- 5.60	- 5.60	54.67	+ 4.10	+ 4.10	50.57
15. MAINTENANCE MANHOURS PER FLYING HOUR	12.36	+ 1.27	+ 11.45	+ 0.78	+ 6.74	11.58	+ 0.49	+ 4.42	11.09
16. NUMBER OF REPARABLE GENERATIONS	2951.00	+374.00	+ 14.51	+623.00	+ 26.76	2328.00	-239.00	- 9.27	2577.00
17. PERCENT BASE REPAIR	57.20	- 2.85	- 2.85	- 1.09	- 1.09	58.29	- 1.76	- 1.76	60.05
18. PERCENT DEPOT REPAIR	42.80	+ 2.85	+ 2.85	+ 1.09	+ 1.09	41.71	+ 1.76	+ 1.76	39.95
19. AVERAGE BASE REPAIR CYCLE	3.64	+ 0.23	+ 6.74	+ 0.52	+ 16.67	3.12	- 0.29	- 8.50	3.41
20. PERCENT ACTIVE REPAIR	74.61	+ 0.12	+ 0.12	- 1.62	- 1.62	76.23	+ 1.74	+ 1.74	74.49
21. PERCENT WHITE SPACE	25.39	- 0.12	- 0.12	+ 1.62	- 1.62	23.77	- 1.74	- 1.74	25.51
22. NUMBER OF ITEMS BACKLOGGED	277.00	0	0	- 22.00	- 7.36	299.00	+ 22.00	+ 7.94	277.00
23. NUMBER OF UNITS DEMANDED	2634.00	+364.00	+ 16.04	+600.00	+ 29.50	2034.00	-236.00	- 10.40	2270.00
24. PERCENT OF DEMANDS NOT SATISFIED	18.38	+ 8.60	+ 8.60	+ 8.97	+ 8.97	9.41	- 0.37	- 0.37	9.78
25. NUMBER OF ITEMS ON BACKORDER	12.00	- 5.00	- 29.41	+ 1.00	+ 9.09	11.00	- 6.00	- 35.29	17.00

TABLE 9 KC-135A LCOM METRICS VALIDATION RESULTS DIFFERENCE ANALYSIS SUMMARY - LORING AFB

CRITICAL OUTPUT VARIABLES MONITORED	COMPARISON OF SIMULATION RESULTS USING ASD STD, METRICS, 1977 BASELINE F-CLOCKS				
	ASD STD. TO 1977 BASELINE % DIFFERENCE	METRICS TO 1977 BASELINE % DIFFERENCE	CLOSEST TO BASELINE	RESULTS USING METRICS F-CLOCKS WITHIN -- 10% OF BASELINE	15% OF BASELINE
1. PERCENT SORTIES ACCOMPLISHED	- 5.87	- 0.90	Metrics	< 1%	
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	+ 0.47	- 0.30	Metrics	< 1%	
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	+ 0.63	- 0.50	Metrics	< 1%	
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	+ 0.84	- 0.09	Metrics	< 0.1%	
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	- 3.86	- 4.13	ASD	< 5%	
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	+ 0.02	0	Metrics	Same as BL	
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	+ 1.03	+ 0.03	Metrics	< 0.1%	
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	+ 0.88	+ 4.25	ASD	< 5%	
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	+ 3.02	+ 0.65	Metrics	< 1%	
10. FLYING HOURS ACCOMPLISHED	- 5.18	- 1.30	Metrics	< 2%	
11. PERCENT AVAILABLE MANHOURS UTILIZED	- 0.04	- 0.04	Same	< 0.1%	
12. ACTUAL MANHOURS USED	- 1.22	- 1.28	ASD	< 2%	
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	+ 0.47	- 0.05	Metrics	< 0.1%	
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	- 0.47	+ 0.05	Metrics	< 0.1%	
15. MAINTENANCE MANHOURS PER FLYING HOUR	+ 4.72	- 0.08	Metrics	< 0.1%	
16. NUMBER OF REPARABLE GENERATIONS	- 5.44	- 3.96	Metrics	< 5%	
17. PERCENT BASE REPAIR	+ 0.53	+ 4.80	ASD	< 5%	
18. PERCENT DEPOT REPAIR	- 0.53	- 4.80	ASD	< 5%	
19. AVERAGE BASE REPAIR CYCLE	- 2.29	+ 1.15	Metrics	< 2%	
20. PERCENT ACTIVE REPAIR	- 1.87	+ 1.13	Metrics	< 2%	
21. PERCENT WHITE SPACE	+ 1.87	- 1.13	Metrics	< 2%	
22. NUMBER OF ITEMS BACKLOGGED	+34.87	+15.79	Metrics		Bet.15 & 16%
23. NUMBER OF UNITS DEMANDED	- 5.07	- 4.08	Metrics	< 5%	
24. PERCENT OF DEMANDS NOT SATISFIED	- 2.20	- 1.53	Metrics	< 2%	
25. NUMBER OF ITEMS ON BACKORDER	-75.00	-75.00	Same		

TABLE 10 KC-135A LCOM METRICS VALIDATION RESULTS DIFFERENCE ANALYSIS SUMMARY - SEYMOUR-JOHNSON AFB

CRITICAL OUTPUT VARIABLES MONITORED	COMPARISON OF SIMULATION RESULTS USING ASD STD, METRICS, 1977 BASELINE F-CLOCKS				
	ASD STD. TO 1977 BASELINE % DIFFERENCE	METRICS TO 1977 BASELINE % DIFFERENCE	CLOSEST TO BASELINE	RESULTS USING METRICS F-CLOCKS WITHIN -- 10% OF BASELINE	15% OF BASELINE
1. PERCENT SORTIES ACCOMPLISHED	+ 1.07	+ 0.57	Metrics	< 1%	
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	- 0.09	0	Metrics	Same as BL	
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	- 0.10	- 0.19	ASD	< 1%	
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	+ 0.02	+ 0.12	ASD	< 1%	
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	- 3.19	- 5.19	ASD	< 6%	
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0	- 0.01	ASD	< 0.1%	
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	+ 0.21	- 0.30	ASD	< 1%	
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	+ 3.16	+ 5.58	ASD	< 6%	
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	+25.41	+15.06	Metrics		Just over 15%
10. FLYING HOURS ACCOMPLISHED	- 4.46	- 0.03	Metrics	< 0.1%	
11. PERCENT AVAILABLE MANHOURS UTILIZED	- 0.21	- 0.28	ASD	< 1%	
12. ACTUAL MANHOURS USED	- 7.94	-10.36	ASD		< 11%
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	- 5.03	- 5.68	ASD	< 6%	
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	+ 5.03	+ 5.68	ASD	< 6%	
15. MAINTENANCE MANHOURS PER FLYING HOUR	- 3.64	-10.23	ASD		< 11%
16. NUMBER OF REPARABLE GENERATIONS	-23.11	-24.57	ASD		
17. PERCENT BASE REPAIR	+ 5.65	+ 8.26	ASD	< 9%	
18. PERCENT DEPOT REPAIR	- 5.65	- 8.26	ASD	< 9%	
19. AVERAGE BASE REPAIR CYCLE	-10.80	-11.06	ASD		< 12%
20. PERCENT ACTIVE REPAIR	+ 0.80	- 1.62	ASD	< 2%	
21. PERCENT WHITE SPACE	- 0.80	+ 1.62	ASD	< 2%	
22. NUMBER OF ITEMS BACKLOGGED	-49.89	-46.31	Metrics		
23. NUMBER OF UNITS DEMANDED	-24.98	-27.29	ASD		
24. PERCENT OF DEMANDS NOT SATISFIED	-16.61	-20.68	ASD		
25. NUMBER OF ITEMS ON BACKORDER	-91.39	-88.08	Metrics		

TABLE 11 KC-135A LCOM METRICS VALIDATION RESULTS DIFFERENCE ANALYSIS SUMMARY - CASTLE AFB

CRITICAL OUTPUT VARIABLES MONITORED	COMPARISON OF SIMULATION RESULTS USING ASD STD, METRICS, 1977 BASELINE F-CLOCKS				
	ASD STD. TO 1977 BASELINE % DIFFERENCE	METRICS TO 1977 BASELINE % DIFFERENCE	CLOSEST TO BASELINE	RESULTS USING METRICS F-CLOCKS WITHIN -- 10% OF BASELINE	15% OF BASELINE
1. PERCENT SORTIES ACCOMPLISHED	+ 1.27	- 1.87	ASD	< 2%	
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	- 0.22	- 0.38	ASD	< 1%	
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	- 0.01	- 0.44	ASD	< 1%	
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	- 0.31	- 0.30	Metrics	< 1%	
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	- 0.20	+ 3.16	ASD	< 4%	
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	- 0.01	- 0.01	Same	< 0.1%	
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	+ 0.42	- 0.36	Metrics	< 1%	
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	+ 2.11	- 1.66	Metrics	< 2%	
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	- 3.40	+ 5.18	ASD	< 6%	
10. FLYING HOURS ACCOMPLISHED	- 6.40	-12.63	ASD		< 13%
11. PERCENT AVAILABLE MANHOURS UTILIZED	+ 0.15	- 0.31	ASD	< 1%	
12. ACTUAL MANHOURS USED	+ 4.29	- 8.75	ASD	< 9%	
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	+ 1.50	- 4.10	ASD	< 5%	
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	- 1.50	+ 4.10	ASD	< 5%	
15. MAINTENANCE MANHOURS PER FLYING HOUR	+11.45	+ 4.42	Metrics	< 5%	
16. NUMBER OF REPARABLE GENERATIONS	+14.51	- 9.27	Metrics	< 10%	
17. PERCENT BASE REPAIR	- 2.85	- 1.76	Metrics	< 2%	
18. PERCENT DEPOT REPAIR	+ 2.85	+ 1.76	Metrics	< 2%	
19. AVERAGE BASE REPAIR CYCLE	+ 6.74	- 8.50	ASD	< 9%	
20. PERCENT ACTIVE REPAIR	+ 0.12	+ 1.74	ASD	< 2%	
21. PERCENT WHITE SPACE	- 0.12	- 1.74	ASD	< 2%	
22. NUMBER OF ITEMS BACKLOGGED	0	+ 7.94	ASD	< 8%	
23. NUMBER OF UNITS DEMANDED	+16.04	-10.40	Metrics		< 11%
24. PERCENT OF DEMANDS NOT SATISFIED	+ 8.60	- 0.37	Metrics	< 1%	
25. NUMBER OF ITEMS ON BACKORDER	-29.41	-35.29	ASD		

TABLE 12 COMPARISON OF CRITICAL KC-135A O AND M PARAMETERS
BASELINE LCOM TO 1977 ACTUALS FOR LORING AFB

CRITICAL O&M PARAMETERS FOR COMPARISON	1977 G033B/D056E ACTUALS	BASELINE LCOM SIMULATION OUTPUT VALUES	DIFFERENCE LCOM-ACTUAL	PERCENT DIFFERENCE
FLYING HOURS PER AIRCRAFT PER YEAR	266.70	354.99	+ 88.29	+ 33.10
SORTIES PER AIRCRAFT PER YEAR	55.50	45.87	- 9.63	- 17.35
AVERAGE OPERATIONAL READY RATE %	64.80	82.69	+ 17.89	+ 17.89
AVERAGE NOT OPERATIONALLY READY - MAINT. %	30.50	8.18	- 22.32	- 22.32
AVERAGE NOT OPERATIONALLY READY - SUPPLY %	4.70	9.13	+ 4.43	+ 4.43
TOTAL MAINT. MANHOURS PER AIRCRAFT PER YEAR	6002.59	4435.87	-1566.72	- 26.10
AVERAGE MAINTENANCE MANHOURS PER FLYING HOUR	22.51	13.10	- 9.41	- 41.80
			AVERAGE PERCENT DIFFERENCE	- 7.45

TABLE 13 COMPARISON OF CRITICAL KC-135A O AND M PARAMETERS
BASELINE LCOM TO 1977 ACTUALS FOR SEYMOUR-JOHNSON AFB

CRITICAL O&M PARAMETERS FOR COMPARISON	1977 G033B/D056E ACTUALS	BASELINE LCOM SIMULATION OUTPUT VALUES	DIFFERENCE LCOM-ACTUAL	PERCENT DIFFERENCE
FLYING HOURS PER AIRCRAFT PER YEAR	305.20	315.62	+ 10.42	+ 3.41
SORTIES PER AIRCRAFT PER YEAR	61.50	41.70	- 19.80	- 32.20
AVERAGE OPERATIONAL READY RATE %	60.60	82.81	+ 22.21	+ 22.21
AVERAGE NOT OPERATIONALLY READY - MAINT. %	35.00	7.76	- 27.24	- 27.24
AVERAGE NOT OPERATIONALLY READY - SUPPLY %	4.40	9.43	+ 5.03	+ 5.03
TOTAL MAINT. MANHOURS PER AIRCRAFT PER YEAR	5473.50	4501.38	- 972.12	- 17.76
AVERAGE MAINTENANCE MANHOURS PER FLYING HOUR	17.93	14.27	- 3.66	- 20.41
		AVERAGE PERCENT DIFFERENCE		- 9.57

TABLE 14 COMPARISON OF CRITICAL KC-135A O AND M PARAMETERS
BASELINE LCOM TO 1977 ACTUALS FOR CASTLE AFB

CRITICAL O&M PARAMETERS FOR COMPARISON	1977 G033B/D056E ACTUALS	BASELINE LCOM SIMULATION OUTPUT VALUES	DIFFERENCE LCOM-ACTUAL	PERCENT DIFFERENCE
FLYING HOURS PER AIRCRAFT PER YEAR	619.70	539.92	- 79.78	- 12.87
SORTIES PER AIRCRAFT PER YEAR	103.50	65.38	- 38.12	- 36.83
AVERAGE OPERATIONAL READY RATE %	39.70	73.24	+ 33.54	+ 33.54
AVERAGE NOT OPERATIONALLY READY - MAINT. %	57.20	12.52	- 44.68	- 44.68
AVERAGE NOT OPERATIONALLY READY - SUPPLY %	3.10	14.24	+ 11.14	+ 11.14
TOTAL MAINT. MANHOURS PER AIRCRAFT PER YEAR	8508.34	5986.92	-2521.42	- 29.63
AVERAGE MAINTENANCE MANHOURS PER FLYING HOUR	13.73	11.09	- 2.64	- 19.23
		AVERAGE PERCENT DIFFERENCE		- 14.08

(5) Compare selected critical O&M output parameters from each base's baseline runs with actual 1977 O&M data taken from the G033B and D056E data systems. This source data used are recorded in Appendix B. The difference analyses for Loring, Seymour-Johnson, and Castle AFB's appear in Tables 12, 13 and 14 respectively.

The comparative analyses of the outputs of the standard and metrics simulation runs against the baseline runs checked the success of the new metrics in simulating base-specific situations. The overall findings of these analyses indicated that the newly developed maintenance metrics were approximately equal to the ASD developed standard KC-135A metrics in producing simulation results similar to the base-specific metrics used in the baseline runs. Both types produced simulated outputs that were generally within 3% of the baseline outputs for Loring and Castle AFB's, and within 9% for Seymour-Johnson AFB. These deviations were considered well within the range of acceptability for most applications of the KC-135A LCOM simulation.

The comparisons of the outputs of the baseline simulation runs with actual 1977 O&M histories at the subject bases measured the overall fidelity of the KC-135A LCOM with the ASD standard input module (except for F-clock values) in reproducing actual base conditions. These comparisons indicated acceptable levels of deviation between the LCOM outputs and actual 1977 field data. The average deviations of the selected O&M parameters were under 10% for Loring and Seymour-Johnson AFB's (see Tables 12 and 13), and under 15% for Castle AFB (see Table 14).

Since the results of the Validation Experiment 1 runs as discussed above showed such low deviations, the optional follow-on experiments shown on the validation plans of Figures 6, 7, and 8 were not performed.

III - CONCLUSION

1. SYNOPSIS

This report describes the work accomplished under Task VIII of an eight task study to: "Develop Maintenance Metrics To Forecast Resource Demands Of Weapon Systems." The purpose of the work discussed in this interim report was the performance of LCOM experiments to provide validation evidence for the maintenance demand prediction metrics developed during the previous tasks. This validation effort was concluded in September 1980. The purpose of the Task VIII validation effort was to demonstrate the accuracy, effects, and confidence that users of the developed methodology could expect when using the new maintenance metrics in place of existing techniques for predicting equipment maintenance demand. The approach to this portion of the study effort was to select and implement existing LCOM simulations of existing aircraft; and to conduct calibrations and validation experiments which simulated existing specific basing situations of the subject aircraft. The calibration runs used existing maintenance demand metrics and the experimental runs used the newly developed maintenance demand metrics. Outputs of the calibrations and experiments were then compared to show how well the new metrics could simulate specific existing conditions compared to present methods. The objective of this validation effort was to provide evidence of the credibility and worth of the new metrics to potential users. The aircraft/basing situations chosen for validation were the F-15A/Bitburg Air Base which was included in the original study data base; and the KC-135A/Loring AFB, KC-135A/Seymour-Johnson AFB, and KC-135A/Castle AFB which were outside the original study data base.

Results of the work accomplished during the Task VIII effort and included in this report are: 1) performance of 15 simulation runs with the F-15A/Bitburg model using various combinations of the existing metrics and the newly developed metrics; 2) comparative analyses among these runs to indicate the credibility and acceptability of the new metrics; 3) performance of 9 simulation runs with the KC-135A/Loring model as in 1) above; 4) difference analyses of the outputs of these runs as in 2) above; 5) performance of 9 simulation runs and difference analyses as in 3) and 4) above with the KC-135A/Seymour-Johnson model; and finally 6) performance of simulation runs and difference analyses as in 3) and 4) above with the KC-135A/Castle model. The newly developed metrics were found acceptable in all cases except for the maintenance demand metric associated with the F-15A propulsion system. The large deviation in simulation results caused by this metric indicates the need for its further modification and/or refinement.

2. PROBLEMS ASSUMPTIONS, AND UNCERTAINTIES

No significant operational problems were encountered during work on Task VIII. The usual difficulties and debugging requirements associated with new applications of large scale computer programs were overcome with much appreciated aid and cooperation of the HRL and ASD personnel concerned. All intended work was accomplished within the time and resources allotted for this portion of the study.

The major assumption underlying the approach to the validation effort was that the capability of the new maintenance demand metrics to provide an adequate portrayal of actual aircraft/base operational and maintenance situations within the context of the LCOM simulation is direct evidence of the accuracy and credibility of the maintenance demand predictions of the newly developed maintenance metric models.

The greatest uncertainty arising from the validation experiments is the uncertainty of whether enough simulation runs were performed in each experimental configuration to provide assurance that random variations in simulation results were averaged out.

3. FINDINGS AND RECOMMENDATIONS

The simulation experiments accomplished during the Task VIII effort provided the following overall findings:

(1) For the F-15A/Bitburg LCOM experiments, the average deviation between the baseline simulation and the simulations using the new metrics for the 25 critical output variables was 8.25% for the eleven avionics systems and 61.83% for the propulsion system.

(2) For the KC-135A/Loring LCOM experiments, the average deviation between the baseline simulations and the new metrics simulations for the 25 critical outputs was 2.85% for all thirty aircraft systems studied; for the KC-135A/Seymour-Johnson experiments, the average deviation was 8.93%; and the the KC-135A/Castle experiments, the average deviation was 2.79%.

(3) The overall fidelity of the KC-135A LCOM was indicated by the following results of comparative analyses of the average deviations between the simulated outputs of the baseline model runs and 1977 actual historical data for seven critical O&M parameters:

KC-135A/Loring	=	7.45%
KC-135A/Seymour-Johnson	=	9.57%
KC-135A/Castle	=	14.08%

The above findings provide evidence that the new maintenance metrics in their present stage of development will produce adequate predictions of equipment maintenance demand for all of the aircraft systems studied, except propulsion, under diverse design, operational, and environmental conditions.

Pursuant to the above findings from the Task VIII validation effort, it is concluded that the newly developed maintenance metrics for all but the propulsion system can be used with some confidence to predict maintenance demands for emerging aircraft systems and/or new basing conditions. It is recommended that the propulsion maintenance metric be used with caution until it is further investigated and refined. It is further recommended that a follow-on study be implemented to refine all of the developed metrics to provide "by-aircraft-type" maintenance demand predictors for even better credibility and data fit. The metrics developed by this study were derived from a population of aircraft which included examples of all types in Air Force inventory (bombers, fighters, transports, and trainers) and so are of a general nature. If these metrics were expanded into separate sets to be specifically applicable to bombers, fighters, transports, and trainers, higher statistical confidence could be placed in their output predictions.

REFERENCES

1. Logistics Composite Model Users Reference Guide, Air Force Logistics Command Report 70-1, AD 703328, Headquarters Air Force Logistics Command, January 1970.

2. The Logistics Composite Model Users Reference Guide, AFLC Report 74-1, Research Division (MCCTR), HQ Air Force Logistics Command, Wright-Patterson AFB, Ohio, January 1970.

3. LCOM II Simulation Software Users Reference Guide, AFMSMET 78-5.1, AFMSMET Wright-Patterson AFB, Ohio, 12 Oct. 1979.

4. Simulating Maintenance Manning for New Weapon Systems; Maintenance Manpower Management During Weapon System Development, AFHRL-TR-74-97(I), Wright-Patterson AFB, Ohio; Advanced Systems Division, Air Force Human Resources Laboratory, ADA 011986, December 1974.

5. Simulating Maintenance Manning for New Weapon Systems: Building and Operating A Simulation Model (Volume II), AFHRL-TR-74-97(II), Air Force Systems Command, Brooks AFB, Texas, December 1974.

6. Simulating Maintenance Manning for New Weapons Systems: Maintenance Data Analysis Programs, AFHRL-TR-7497(III), Wright-Patterson AFB, Ohio, Advanced Systems Division, Air Force Human Resources Laboratory, ADA 025342, 1975.

7. Simulating Maintenance Manning for New Weapon Systems: Data Base Management Programs, AFHRL-TR-74-97(IV), Wright-Patterson AFB, Ohio, Advanced Systems Division, AF Human Resources Lab, ADA 011989, December 1974.

8. Simulating Maintenance Manning for New Weapon Systems: Manpower Program, AFHRL-TR-74-97(V), Wright-Patterson AFB, Ohio, Advanced Systems Division, Air Force Human Resources Lab, ADA 011990, 1975.

9. Simulating Maintenance Manning for New Weapon Systems: Volume VI, Maintenance Manpower Matrix Program, AFHRL-TR-74-97(VI), Air Force Systems Command, Brooks AFB, Texas, May 1976.

10. Logistics Composite Model (LCOM) Study Report, KC-135A Simulation Study, un-numbered document, Wright-Patterson AFB, Ohio, Modeling and Analysis Branch, Deputy for Engineering, Aeronautical Systems Division (ASD, ENESA), October 1979.

GLOSSARY OF ABBREVIATIONS

AB	Air Base
Acft	Aircraft
AFB	Air Force Base
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AMAD	Actual Maintenance Action Demand
ASD	Advanced Systems Division
BMW	Bomb Wing
EMAD	Estimated Maintenance Action Demand
F-Clock	Failure Clock
FTW	Fighter Training Wing
Gen	Generator
IFF	Identification Friend or Foe
Indic	Indicator
I/O	Input/Output
LCOM	Logistics Composite Model
LOX	Liquid Oxygen
MAC	Military Airlift Command
MAD	Maintenance Action Demand
Maint	Maintenance
MAW	Military Airlift Wing
NAV	Navigation
O&S	Operations and Support
PS/EAC	Product Support/Experience Analysis Center
Ref	Reference
SAC	Strategic Air Command
TFW	Tactical Fighter Wing
TR	Technical Report
TTW	Tactical Training Wing
UHF	Ultra High Frequency
WUC	Work Unit Code

APPENDIX A

F-15A/BITBURG LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE A1 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS (F-15A/BITBURG)

EQUIPMENT SUBSYSTEM (F-15A)	F-15A SUBSYSTEM WUC	F-15A LCOM F CLOCK	MAINT. METRIC MODEL WUC'S	ACTUAL MAINT. ACTION DEMAND PER UNIT PER YEAR						PARTIAL AMAD (MODEL WUC'S)
				LCOM R +	LCOM M +	LCOM H =	TOTAL MAD ÷	NO. UNITS =	AMAD	
Propulsion - Eng. #1	23XXX	F23000	23XXX	290	304	416	1010	32	31.56	31.56
Eng. #2		F27000		290	303	416	1009	32	31.53	31.53
Flight Indicators	51A	F51A00	51AD 51AH 51AK	46	20	11	77	32	2.406	0.88
Air Data Subsystem	51E	F51E00	51EA 51ED	18	34	25	77	32	2.406	0.94
Horizontal Situation Indicator	51N	F51N00	51NA 51NB	41	7	45	93	32	2.906	2.09
Autopilot	52A	F52A00	52AA 52AB	35	18	57	110	32	3.437	0.88
UHF Communication Set	63A	F63A00	63AA 63AG	108	93	75	276	32	8.625	5.03
IFF Transponder Set	65A	F65A00	65AA	82	240	80	402	32	12.562	2.22
Inertial Navigation Set	71A	F71A00	71AE 71AK	124	13	174	311	32	9.718	4.34
Instrument Landing Set	71C	F71C00	71CA	1	2	2	5	32	0.156	0.03
Tacan Set	71D	F71D00	71DA	59	12	37	108	32	3.375	1.56
Attitude-Heading Reference Set	71F	F71F00	71FA 71FB	50	2	29	81	32	2.531	1.31
Radar Set	74F	F74F00	74FA 74FC 74FH 74FR/FQ 74FS	538	64	425	1027	32	32.093	11.13

TABLE A2 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS (F-15A/BITBURG)

F-15A LCOM F CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A	+ (B1	* X1)	+ (B2	* X2)	+ (B3	* X3)	+ (B4	* X4)	+ (B5	* X5)	+ (B6	* X6)	+ (B7	* X7)	= PEMAD	÷ AMAD / PAMAD	= TOTAL EMAD
F23000 F27000	-57.675	+0.244	64.00 P02	+0.055	300.00 P04	+0.021	2000.00 Ø10	+0.203	148.34 Ø27	-0.798	1.00 Ø32	+7.509	1.51 Ø33			57.094 1.392	1.000 2.734	57.094 3.806
F51A00	- 4.658	+0.398	0.72 A03	+0.0004	3750.00 Ø13	+0.0016	223.53 Ø17	-0.0036	240.00 E03	+0.045	106.00 E19							
F51E00	- 1.975	+0.023	11.87 A03	-0.035	6.80 A16	-0.0008	6000.00 Ø08	+0.0005	3750.00 Ø13	-0.071	1.00 Ø23	-0.046	19.00 E13	+0.063	106.00 E19	0.868	2.559	2.221
F51N00	-14.292	+0.751	1.36 A07	+1.003	6.80 A16	-0.049	33.50 Ø14	+3.020	1.51 Ø33	+0.177	32.00 E20					2.132	1.390	2.964
F52A00	+21.944	-0.481	11.00 A03	+0.0159	432.00 A04	-1.496	1.47 A13	-0.258	83.85 A19	-0.0004	6000.00 Ø08	+0.637	1.00 Ø23	+0.016	188.00 E18	0.934	3.905	3.648
F63A00	-101.62	-0.208	26.00 A03	+1.011	9.62 A05	-0.016	6000.00 Ø08	+6.732	7.90 Ø18	+1.415	188.00 E18	+0.419	106.00 E19	-60.986	2.75 E30	2.603	1.714	4.461
F65A00	+ 0.890	+0.602	3.00 A02	-0.026	0.00 A09	-0.813	2.30 Ø30	+0.0078	202.00 E09							2.401	5.658	13.588
F71A00	- 0.034	+0.346	18.65 A05													6.418	2.239	14.371
F71C00	- 1.128	+0.025	35.00 A06*	+0.0040	363.02 Ø15	-0.0074	148.34 Ø27	-0.025	32.00 E20							-0.698	5.200	**
F71D00	- 1.843	+0.061	29.00 A03	-0.044	25.00 A18	+0.099	1.00 Ø32	+0.0058	240.00 E03	-0.017	202.00 E09	+0.142	32.00 E20			1.475	2.163	3.192
F71F00	-11.435	-1.967	4.00 A08	+0.155	150.00 Ø05	-0.056	53.00 E27									0.979	1.932	1.891
F74F00	-163.53	-7.695	3.00 A02	+0.209	76.00 A12	+2.017	84.00 A19	+0.0013	2250.00 Ø11	+0.271	19.00 E13	+0.138	32.00 E20			11.187	2.883	32.252

* No data from Bitburg used value of A06 from F-15A's at Luke AFB.
** Operating point from Bitburg in indeterminate region of estimating model.

TABLE A3 CALCULATION OF METRIC-MODEL-ADJUSTED F-CLOCK VALUES (F-15A/BITBURG)

F-15A LCOM F CLOCK	$\frac{AMAD}{BMAD}$	PRESENT CLOCK VALUE	METRIC MODEL ADJUSTED CLOCK
F23000	0.552	12	7
F27000	0.632	126	80
F51A00			
F51E00	1.083	145	157
F51N00	0.980	145	142
F52A00	0.941	91	86
F63A00	1.933	32	62
F65A00	0.924	18	17
F71A00	0.676	26	18
F71C00		108	
F71D00	1.057	83	88
F71F00	1.338	117	157
F74F00	0.995	9	9

APPENDIX B

KC-135A/LORING AFB, SEYMOUR-JOHNSON AFB, AND CASTLE AFB
EQUIPMENT, OPERATIONS, SUPPORT, AND ENVIRONMENTAL

SOURCE DATA (FROM G033B, D056E, AND METRICS DATA BASE)

TABLE B1-1--B1-30	1977 Maintenance Action Demand (Three Bases by Metrics Study Equipments)
TABLE B2-1--B2-30	Equipment, Operations, and Environment Regression Equation Independent Variable Data
TABLE B3-1--B3-3	Test Bases 1977 Operations and Support Parameter Data

TABLE B1-1

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: PROPULSION

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#1 23XXX	5267	2188	1709
METRICS/LCOM EQUIPMENTS			
23A	112	43	28
23B	375	53	124
23C	164	90	67
23D	58	37	13
23E	329	49	75
23H	384	152	169
23J	646	313	296
23K	500	258	213
23L	325	212	108
23M	832	246	149
23N	270	143	22
23P	584	320	199
23R	508	222	160
230	60	7	74
Other	120	43	12

TABLE B1-2

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: FLIGHT INDICATORS

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#2 511	400	143	103
METRICS/LCOM EQUIPMENTS			
51116	20	2	7
51132	27	8	4
Other	353	133	92

TABLE B1-3

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: AIR DATA SYSTEM

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#3 51B	221	77	62
METRICS/LCOM EQUIPMENTS			
51BA	25	8	9
51BE	87	22	15
Other	109	47	38

TABLE B1-4

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: HORIZONTAL SITUATION INDICATOR

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#4 51A	736	211	124
METRICS/LCOM EQUIPMENTS			
51AAD	97	10	22
51AC	38	10	9
51AD	25	4	6
Other	576	187	87

TABLE B1-5

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: AUTOPILOT

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#5 521	463	232	77
METRICS/LCOM EQUIPMENTS			
52111	130	38	16
52113	96	38	10
52141	55	---	8
52121	49	22	3
52122	30	10	2
52123	28	3	---
Other	75	121	38

TABLE B1-6

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: UHF COMMUNICATION SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#6			
63A	320	362	79
and 63R	70	---	23
	390	362	102
METRICS/LCOM EQUIPMENTS			
63AF	201	248	60
63AH	19	26	5
Other	170	88	37

TABLE B1-7

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: IFF TRANSPONDER

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#7 65B	199	92	69
METRICS/LCOM EQUIPMENTS			
65BAA	70	45	27
65BBB	51	16	16
Other	78	31	26

TABLE B1-8

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: INERTIAL NAVIGATION SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#8	NOT IN AIRCRAFT		
METRICS/LCOM EQUIPMENTS			

TABLE B1-9

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: INSTRUMENT LANDING SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#9 71B	111	73	19
METRICS/LCOM EQUIPMENTS			
71BCF	18	4	2
71AAA	17	2	5
Other	76	67	12

TABLE B1-10

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: TACAN SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#10 71C	296	212	131
METRICS/LCOM EQUIPMENTS			
71CA	229	165	90
Other	67	47	41

TABLE B1-11

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: ATTITUDE-HEADING REFERENCE SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#11	NOT IN AIRCRAFT		
METRICS/LCOM EQUIPMENTS			

TABLE B1-12

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: RADAR SET

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#12 72B	1048	549	351
METRICS/LCOM EQUIPMENTS			
72BDA	230	144	90
72BFA	244	167	86
Other	574	238	175

TABLE B1-13 & -14

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: #13 - RADOME AND #14 WINDSHIELD (AIRFRAME)

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#13 & #14 111	417	373	117
METRICS/LCOM EQUIPMENTS			
#13-1111J	24	9	6
#14-1114M	76	1	25
Other	317	363	86

TABLE B1-15

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: WINGS

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#15 (No Top WUC)	951	567	617
METRICS/LCOM EQUIPMENTS			
11A	162	75	46
11J	341	204	255
11K	256	197	278
11L	3	4	2
116	105	36	17
117	84	51	19

TABLE B1-16

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: COCKPIT FURNISHINGS (SEATS)

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#16 12A	33	29	16
METRICS/LCOM EQUIPMENTS			
12AA0	20	10	13
Other	13	19	3

TABLE B1-17

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: MAIN LANDING GEAR

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#17 13A	1232	525	239
METRICS/LCOM EQUIPMENTS			
13AMF	709	140	92
13AMG	71	25	30
Other	452	360	117

TABLE B1-18

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: BRAKES

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#18 13C	566	337	73
METRICS/LCOM EQUIPMENTS			
13CA	415	206	42
Other	151	131	31

TABLE B1-19

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: STABILATOR

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#19 (No Top WUC)	67	68	16
METRICS/LCOM EQUIPMENTS			
11G (Assy)	57	67	13
1151 (Skin)	10	1	3

TABLE B1-20

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: RUDDER

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#20 14B	215	177	32
METRICS/LCOM EQUIPMENTS			
14BF Other	21 194	17 160	1 31

TABLE B1-21

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: FLAPS

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#21 14E	509	520	164
METRICS/LCOM EQUIPMENTS			
14EF	112	67	32
14EG	91	58	46
Other	299	395	86

TABLE B1-22

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: ENVIRONMENTAL CONTROL

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#22 412	164	69	40
METRICS/LCOM EQUIPMENTS			
41214	2	3	5
Other	162	66	35

TABLE B1-23

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: ELECTRIC POWER GENERATION

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#23 421	732	355	276
METRICS/LCOM EQUIPMENTS			
4215L Other	61 671	48 307	31 245

TABLE B1-24 & -25

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: #24 ANTI-COLLISION LIGHTS #25 LANDING AND TAXI LIGHTS

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#24 & #25 N1A (442)	365	227	55
METRICS/LCOM EQUIPMENTS			
#24-4425	18	5	4
#25-44211 (Landing)	29	13	7
44212 (Taxi)	16	6	---
Other	302	203	44

TABLE B1-26

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: HYDRAULIC POWER SYSTEM

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#26 451	822	501	139
METRICS/LCOM EQUIPMENTS			
4511E	66	96	8
45118	188	26	12
Other	568	379	119

TABLE B1-27

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: INTERNAL FUEL SYSTEM

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#27			
(1) 461 and	209	132	25
(2) 462 and	239	148	20
(3) 463	173	70	11
	621	350	56
METRICS/LCOM EQUIPMENTS			
(1) 46130	35	17	---
46170	130	101	1
Other	44	14	
(2) 46210	163	108	2
46240	61	11	1
Other	15	29	17
(3) 46310	77	40	2
46340	81	30	---
Other	15	0	9

TABLE B1-28 & -29

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: #28 OXYGEN REGULATOR   #29 LOX CONVERTER

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#28 & #29 471	211	118	69
METRICS/LCOM EQUIPMENTS			
#28-47131	125	36	47
#29-47111	9	22	2
Other	77	60	20

TABLE B1-30

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA
1977 MAINTENANCE ACTION DEMAND (MAD)

SUBSYSTEM: FIRE DETECTION SYSTEM

WORK UNIT CODE	BASE: DESR CASTLE AFB NO. ACFT: 31	BASE: NRCH LORING AFB NO. ACFT: 27	BASE: VKAG SEYMOUR-JOHNSON AFB NO. ACFT: 13
SUBSYSTEM	TOTAL MAD	TOTAL MAD	TOTAL MAD
#30 494	419	124	69
METRICS/LCOM EQUIPMENTS			
49421	267	74	42
Other	152	50	27

TABLE B2-1

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #1 PROPULSION

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	P02	P04	010	027	032	033	
CASTLE AFB	124.00	432.00	2900.00	10.3	6.00	0.90	
LORING AFB	108.00	432.00	2900.00	5.60	6.00	4.80	
SEYMOUR-JOHNSON AFB	52.00	432.00	2900.00	6.20	6.00	5.00	
VARIABLE NAMES AND UNITS	Total number of installed engines per base	Weight per engine lbs. $(10)^{-1}$	Avg. cruise altitude feet $(10)^{-1}$	Operational sorties per aircraft per year (or simulated ops. sorties)	Aircraft crew size	Avg. sortie length in hours	

TABLE B2 -2

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #2 FLIGHT INDICATORS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A03	013	017	E03	E19		
CASTLE AFB	1.00	3500.00	62.0	120.00	54.00		
LORING AFB	1.00	3500.00	26.70	190.00	110.00		
SEYMOUR-JOHNSON AFB	1.00	3500.00	30.50	80.00	88.00		
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Min. landing distance	Operations flight hours per aircraft per year	Runway direction in compass degrees	20-29 MPH max. cross-wind days per year		

TABLE B2 -3

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #3 AIR DATA SYSTEM

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A03	A16	008	013	023	E13	E19
CASTLE AFB	2.07	2.29	1750.00	3500.00	10.0	3.00	54.00
LORING AFB	2.07	2.29	1750.00	3500.00	9.0	23.00	110.00
SEYMOUR-JOHNSON AFB	2.07	2.29	1750.00	3500.00	4.0	57.00	88.00
VARIABLE NAMES AND UNITS	Equipment weight lbs.	On-off cycles per 10 flying hour	Avg. climb rate feet	Min. landing distance feet	Avg. no. aircraft on alert per month	No. of thunder days per year	20-29 MPH max. cross-wind days per year

TABLE B2 -4

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #4 HORIZONTAL SITUATION INDICATOR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A07	A16	014	033	E20		
CASTLE AFB	1.49	2.02	127.50	5.90	15.00		
LORING AFB	1.49	2.02	127.50	4.80	25.00		
SEYMOUR-JOHNSON AFB	1.49	2.02	127.50	5.00	17.00		
VARIABLE NAMES AND UNITS	Cooling method scaled	On-off cycles per 10 flight hours	Avg. landing weight lbs.	Avg. sortie length hrs.	30-39 MPH max. cross-wind days per year		

TABLE B2-5

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #5 AUTOPILOT

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A03	A04	A13	A19	008	023	E18
CASTLE AFB	18.14	976.09	6.01	85.00	1750.00	10.0	243.00
LORING AFB	18.14	976.09	6.01	85.00	1750.00	9.0	186.00
SEYMOUR-JOHNSON AFB	18.14	976.09	6.01	85.00	1750.00	4.0	215.00
VARIABLE NAMES AND UNITS	Equipment weight in lbs.	Equipment volume in ^{3}	Avg. op. time per sortie hours	Failure/abort ratio percent	Avg. climb rate feet per minute	Avg. no. of aircraft on alert per month	10-19 MPH max. cross-wind days per year

TABLE B2 -6

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #6 UHF COMMUNICATION SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A03	A05	008	018	E18	E19	E30
CASTLE AFB	41.65	6.52	1750.00	31.0	243.00	54.00	Like Travis 2.94
LORING AFB	41.65	6.52	1750.00	13.30	186.00	110.00	Like Plattsburgh 2.69
SEYMOUR-JOHNSON AFB	41.65	6.52	1750.00	15.30	215.00	88.00	Like Myrtle Beach 3.42
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Number of SRUs per U.E.	Avg. climb rate feet per minute	Mis. flying hours per aircraft per year	10-19 MPH max. cross-wind days per year	20-29 MPH max. cross-wind days per year	Avg. visual obstruction type

TABLE B2-7

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #7 IFF TRANSPONDER

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A02	A09	030	E09			
CASTLE AFB	1.00	24.13	0.9	69.00			
LORING AFB	1.00	24.13	0.9	146.00			
SEYMOUR-JOHNSON AFB	1.00	24.13	0.9	144.00			
VARIABLE NAMES AND UNITS	Equipment location on aircraft scaled	Number test points per U.E.	Max. aircraft speed nominal mach no.	Number rain days per year			

TABLE B2-8

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #8 INERTIAL NAVIGATION SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
CASTLE AFB		NOT ON AIRCRAFT					
LORING AFB							
SEYMOUR-JOHNSON AFB							
VARIABLE NAMES AND UNITS							

AD-A096 690 BOEING AEROSPACE CO SEATTLE WA PRODUCT SUPPORT/EXPER--ETC F/G 5/1
DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS--ETC(U)
NOV 80 D K HINDES, G A WALKER, D H WILSON F33615-77-C-0075
UNCLASSIFIED D194-10089-4 NL

2 OF 2
AD A
096690

END
DATE
FILMED
4-81
DTIC

TABLE B2 -9

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #9 INSTRUMENT LANDING SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A06	015	027	E20			
CASTLE AFB	47.00	619.70	10.3	15.00			
LORING AFB	47.00	266.70	5.60	25.00			
SEYMOUR-JOHNSON AFB	47.00	305.20	6.20	17.00			
VARIABLE NAMES AND UNITS	Operating temp. environment degrees F	Total flying hours per aircraft per year	Operations sorties per aircraft per year (or simulated ops. sorties)	30-39 MPH max. cross-wind days per year			

TABLE B2-10

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #10 TACAN SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A03	A18	032	E03	E09	E20	
CASTLE AF3	45.00	20.00	6.00	120.00	69.00	15.00	
LORING AFB	45.00	20.00	6.00	190.00	146.00	25.00	
SEYMOUR-JOHNSON AFB	45.00	20.00	6.00	80.00	144.00	17.00	
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Ground/flight operating ratio in percent	Aircraft crew size	Runway direction compass degrees	Number rain days per year	30-39 MPH max. cross-wind days per year	

TABLE B2-11

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #11 ATTITUDE-HEADING REFERENCE SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A08	005	E27				
CASTLE AFB	2.00	150.00	20.00				
LORING AFB	2.00	150.00	181.00				
SEYMOUR-JOHNSON AFB	2.00	150.00	55.00				
VARIABLE NAMES AND UNITS	Protection devices scaled value	Avg. takeoff speed knots	Days per year min. temp. below 32°F				

TABLE B2-12

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #12 RADAR SET

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	A02	A12	A19	011	E13	E20	
CASTLE AFB	2.14	4.00	87.00	4000.00	3.00	15.00	
LORING AFB	2.14	4.00	87.00	4000.00	23.00	25.00	
SEYMOUR-JOHNSON AFB	2.14	4.00	87.00	4000.00	57.00	17.00	
VARIABLE NAMES AND UNITS	Equipment location on aircraft scaled value	AGE unreliability percent	Failure/abort ratio percent	Avg. descent rate feet per minute	Number thunder days per year	30-39 MPH max. cross-wind days per year	

TABLE B2-13

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #13 RADOME

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F08	005	021	E20			
CASTLE AFB	1.00	150.00	58.1	15.0			
LORING AFB	1.00	150.00	15.80	25.0			
SEYMOUR-JOHNSON AFB	1.00	150.00	18.70	17.0			
VARIABLE NAMES AND UNITS	Predominant type failure problems scaled value	Avg. takeoff speed knots	Operations landings per aircraft per year (or simulated ops. landings	30-39 MPH max. cross-winds days per year			

TABLE B2-14

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #14 WINDSHIELD

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F07	015	021	027	E18		
CASTLE AFB	100.00	619.70	58.1	10.3	243.00		
LORING AFB	100.00	266.70	15.80	5.60	186.00		
SEYMOUR-JOHNSON AFB	100.00	305.20	18.70	6.20	215.00		
VARIABLE NAMES AND UNITS	Support equipment reliability percent	Total flying hours per aircraft per year	Ops. landings per aircraft per year	Ops. sorties per aircraft per year	10-19 MPH max. cross-wind days per year		

TABLE B2-15

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #15 WINGS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F04	008	012	014	021	E13	E20
CASTLE AFB	1156.70	1750.00	115.00	127.50	58.1	3.00	15.00
LORING AFB	1156.70	1750.00	115.00	127.50	15.80	23.00	25.00
SEYMOUR-JOHNSON AFB	1156.70	1750.00	115.00	127.50	18.70	57.00	17.00
VARIABLE NAMES AND UNITS	Equipment volume feet ^{3}	Avg. climb rate feet per minute	Avg. landing speed knots	Avg. landing weight lbs. $(10)^{-3}$	Ops. landings per aircraft per year (or simulated ops.)	Number thunder days per year	30-39 MPH max. cross-wind days per year

TABLE B2-16

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #16 SEATS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	008	012	017	021	025	027	E19
CASTLE AFB	1750.00	115.00	62.0	58.0	103.50	10.3	54.00
LORING AFB	1750.00	115.0	26.70	15.80	55.50	5.60	110.00
SEYMOUR-JOHNSON AFB	1750.00	115.00	30.50	18.70	61.50	6.20	88.00
VARIABLE NAMES AND UNITS	Avg. climb rate feet per minute	Avg. landing speed knots	Ops. flying hour per aircraft per year (or simulated ops.)	Ops. landings per aircraft per year (or simulated ops.)	Total sorties per aircraft per year	Ops. sorties per aircraft per year (or simulated ops.)	20-29 MPH max. cross-wind days per year

TABLE B2-17

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #17 MAIN LANDING GEAR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F06	F13	014	019	F03		
CASTLE AFB	1.00	1.30	127.50	580.70	2960.00		
LORING AFB	1.00	1.30	127.50	157.50	2960.00		
SEYMOUR-JOHNSON AFB	1.00	1.30	127.50	186.60	2960.00		
VARIABLE NAMES AND UNITS	Support equipment complexity (scaled value)	Removals to access other equipment per year	Avg. landing weight lbs. $(10)^{-3}$	Total landings per aircraft per year	Equipment weight lbs.		

TABLE B2-18

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #18 BRAKES

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F09	003	005	026	031	E03	
CASTLE AFB	90.00	1.20	150.00	88.0	5200.00	120.00	
LORING AFB	90.00	1.20	150.00	47.20	5200.00	190.00	
SEYMOUR-JOHNSON AFB	90.00	1.20	150.00	52.30	5200.00	80.00	
VARIABLE NAMES AND UNITS	Inflight squawk verification rate percent	Avg. mission mix scaled value	Avg. takeoff speed knots	Training sorties per aircraft (pure training as oppoed to ops. training)	Service ceiling feet (10)	Runway direction compass degrees	

TABLE B2-19

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #19 STABILATOR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F03	F06	021	E20			
CASTLE AFB	1600.00	5.00	58.1	15.00			
LORING AFB	1600.00	5.00	15.80	25.00			
SEYMOUR-JOHNSON AFB	1600.00	5.00	18.70	17.00			
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Support equipment complexity scaled	Ops. landing per aircraft per year (or simulated ops.)	30-39 MPH max. cross-wind days per year			

TABLE B2-20

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #20 RUDDER

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	015	034	E03				
CASTLE AFB	619.70	0.03	120.00				
LORING AFB	266.70	0.00	190.00				
SEYMOUR-JOHNSON AFB	305.20	0.08	80.00				
VARIABLE NAMES AND UNITS	Total flight hour per aircraft per year	Accidents per aircraft per year	Runway direction compass degrees				

TABLE B2 -21

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #21 FLAPS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F03	F06	F08	015	027	E18	E19
CASTLE AFB	550.00	1.00	4.00	619.70	10.3	243.00	54.00
LORING AFB	550.00	1.00	4.00	266.70	5.60	186.00	110.00
SEYMOUR-JOHNSON AFB	550.00	1.00	4.00	305.20	6.20	215.00	88.00
VARIABLE NAMES AND UNITS	Equipment weight lbs. (10)-1	Support equipment complexity scaled	Predominant type failure problems scaled	Total flying hour per aircraft per year	Ops. sorties per aircraft per year (or simulated ops.)	10-19 MPH max. crosswind days per year	20-29 MPH max. crosswind days per year

TABLE B2-22

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #22 WATER SEPARATOR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	E19	E24					
CASTLE AFB	54.00	41.08					
LORING AFB	110.00	16.50					
SEYMOUR-JOHNSON AFB	88.00	36.08					
VARIABLE NAMES AND UNITS	20-29 MPH max. cross-wind days per year	Mean min. temperature normalized degrees F					

TABLE B2-23

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #23 ELECTRICAL GENERATOR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F13	007					
CASTLE AFB	0.48	82.00					
LORING AFB	0.48	82.00					
SEYMOUR-JOHNSON AFB	0.48	82.00					
VARIABLE NAMES AND UNITS	Removals to access other equipment per aircraft per year	Avg. takeoff weight in percent of max. take-off weight					

TABLE B2-24

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #24 ANTI-COLLISION LIGHTS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F03	F06	011	021	025	027	E30
CASTLE AFB	4.00	3.00	4000.00	58.1	103.50	10.3	Like Travis 2.90
LORING AFB	4.00	3.00	4000.00	15.80	55.50	5.60	Like Plattsburgh 2.69
SEYMOUR-JOHNSON AFB	4.00	3.00	4000.00	18.70	61.50	6.20	Like Myrtle Beach 3.42
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Support equipment complexity scaled	Avg. descent rate of aircraft feet per minute	Ops. landings per aircraft per year (or simulated ops.)	Total sorties per aircraft per year	Ops. sorties per aircraft per year (or simulated ops.)	Avg. visual obstruction type scaled

TABLE B2-25

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #25 LANDING/TAXI LIGHTS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F03	F13	015	E18	E19		
CASTLE AFB	9.50	0.00	619.70	243.00	54.00		
LORING AFB	9.50	0.00	266.70	186.00	110.00		
SEYMOUR-JOHNSON AFB	9.50	0.00	305.20	215.00	88.00		
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Removals to access other equipment per aircraft per year	Total flight hour per aircraft per year	10-19 MPH max. cross-wind days per year	20-29 MPH max. cross-wing days per year		

TABLE B2-26

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #26 HYDRAULIC PUMPS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F11	008	014	032	033	E06	E08
CASTLE AFB	10.00	1750.00	127.50	6.00	5.90	2.00	0.00
LORING AFB	10.00	1750.00	127.50	6.00	4.80	114.00	20.06
SEYMOUR-JOHNSON AFB	10.00	1750.00	127.50	6.00	5.00	5.00	0.00
VARIABLE NAMES AND UNITS	Ground to flight operating ratio	Avg. climb rate feet per minute	Avg. landing weight lbs. $(10)^3$	Aircraft crew size	Avg. sortie length hours	Number of snow days per year	Mean snow depth inches

TABLE B2-27

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #27 FUEL TANKS

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F16	010	015	021	027	E18	E19
CASTLE AFB	3.00	2900.00	619.70	58.1	10.3	243.00	54.00
LORING AFB	3.00	2900.00	266.70	15.80	5.60	186.00	110.00
SEYMOUR-JOHNSON AFB	3.00	2900.00	305.20	18.70	6.20	215.00	88.00
VARIABLE NAMES AND UNITS	Equipment protection methodology scaled	Avg. cruise altitude feet (10)	Total flying hours per aircraft per year	Ops landings per aircraft per year (or simulated ops.)	Ops. sorties per aircraft per year (or simulated ops.)	10-19 MPH max. cross-wind days per year	20-29 MPH max. cross-wind days per year

TABLE B2-28

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #28 OXYGEN REGULATOR

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F03	030	E06	E07	E21	E24	E27
CASTLE AFB	3.00	0.90	2.00	0.00	1.00	41.08	20.00
LORING AFB	3.00	0.90	114.00	160.50	3.00	16.50	181.00
SEYMOUR-JOHNSON AFB	3.00	0.90	5.00	0.00	5.00	36.08	55.00
VARIABLE NAMES AND UNITS	Equipment weight lbs.	Max. aircraft speed nominal mach no.	Number of snow days per year	Avg. total snow fall per year inches	40-49 max. cross-wind days per year	Mean min. temperature normalized ^{o}F	Days min. temp. below $32^{o}F$ per year

TABLE B2-29

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION
EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #29 LOX CONVERTER

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F08	005	006	033			
CASTLE AFB	4.00	150.00	9500.00	5.90			
LORING AFB	4.00	150.00	9500.00	4.80			
SEYMOUR-JOHNSON AFB	4.00	150.00	9500.00	5.00			
VARIABLE NAMES AND UNITS	Predominant type of failure problems scaled	Avg. takeoff speed knots	Median takeoff distance feet	Avg. sortie length hour			

TABLE B2-30

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

EQUIPMENT, OPERATIONS, & ENVIRONMENT REGRESSION EQUATION INDEPENDENT VARIABLE DATA

SUBSYSTEM: #30 ENGINE FIRE DETECTION

KC-135A TEST BASES	VARIABLE I.D. NUMBER						
	F08	E16	E19	E24			
CASTLE AFB	9.00	315.00	54.00	41.08			
LORING AFB	9.00	315.00	110.00	16.50			
SEYMOUR-JOHNSON AFB	9.00	225.00	88.00	36.08			
VARIABLE NAMES AND UNITS	Predominant type of failure problems scaled	Predominant wind direction compass degrees	20-29 max. cross-wind days per year	Mean minimum temp. normalized degrees F^{o}			

TABLE B3-1

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

TEST BASES 1977 OPERATIONS AND SUPPORT PARAMETER DATA

BASE: LORING AFB (NRCH)

VARIABLE I.D. NUMBER	AVG. NO. WEAPON (ACFT)	PERCENT OR	PERCENT TOTAL NORM	PERCENT UNSCH. MAINT. NORM	PERCENT SCHED. MAINT. NORM.	PERCENT NORM F	PERCENT NORS			TOTAL FLYING HOURS (1977)	TOTAL SORTIES (1977)	TOTAL LANDINGS (1977)
							TOT	G	F			
1977 MAY	27	63.8	32.7	26.3	0.0	6.4	3.5	3.5	0.0	535	107	307
JUN	25	69.4	28.6	20.7	0.4	7.5	2.0	1.9	.1	701	165	523
JUL	25	60.6	34.9	18.7	1.1	15.1	4.5	3.6	.9	557	122	348
AUG	25	61.7	30.9	17.6	.7	12.6	7.4	5.5	1.9	676	133	345
SEP	26	68.6	25.0	15.4	.7	8.9	6.4	5.4	.9	648	131	432
12 MO. AVG.	26	64.8	30.4	19.7	.6	10.1	4.8	4.0	.8	7481	1579	4692

TABLE B3-2

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

TEST BASES 1977 OPERATIONS AND SUPPORT PARAMETER DATA

BASE: SEYMOUR JOHNSON AFB (VKAG)

VARIABLE I.D. NUMBER	AVG. NO. WEAPON (ACFT)	PERCENT OR	PERCENT TOTAL NORM	PERCENT UNSCH. MAINT. NORM	PERCENT SCHED. MAINT. NORM.	PERCENT NORM F	PERCENT NORS			TOTAL FLYING HOURS (1977)	TOTAL SORTIES (1977)	TOTAL LANDINGS (1977)
							TOT	G	F			
1977 MAY	14	59.1	35.9	26.6	6.4	2.9	5.1	3.6	1.4	275	61	155
JUN	13	60.3	34.0	29.3	2.5	2.2	5.7	4.8	.9	303	61	170
JUL	13	59.9	37.4	32.6	1.2	3.6	2.7	2.6	.0	229	50	162
AUG	13	57.6	37.6	30.3	3.9	3.4	4.7	3.3	1.5	371	84	239
SEP	12	66.9	29.5	20.6	4.3	4.6	3.6	.9	2.7	396	70	255
12 MO. AVG.	13	60.8	34.9	27.9	3.7	3.3	4.3	3.0	1.3	3778	782	2354

TABLE B3-3

KC-135A METRICS VALIDATION EXPERIMENTS SOURCE DATA

TEST BASES 1977 OPERATIONS AND SUPPORT PARAMETER DATA

BASE: CASTLE AFB (DESR)

VARIABLE I.D. NUMBER	AVG. NO. WEAPON (ACFT)	PERCENT OR	PERCENT TOTAL NORM	PERCENT UNSCH. MAINT. NORM	PERCENT SCHED. MAINT. NORM.	PERCENT NORM F	PERCENT NORS			TOTAL FLYING HOURS (1977)	TOTAL SORTIES (1977)	TOTAL LANDINGS (1977)
							TOT	G	F			
1977 MAY	26	43.2	51.5	27.2	8.9	15.4	5.3	2.3	3.0	1486	236	1396
JUN	27	48.1	48.0	20.1	9.6	18.3	3.9	2.7	1.2	1424	240	1352
JUL	32	37.7	60.4	20.4	13.7	26.3	1.9	1.6	.4	1497	247	1484
AUG	37	32.8	66.2	34.0	9.8	22.4	1.0	.3	.7	1602	268	1756
SEP	37	40.1	55.9	28.1	10.4	17.5	4.0	.4	3.6	1646	277	1663
12 MO. AVG.	32	40.4	56.4	26.0	10.4	20.0	3.2	1.4	1.8	18372	3043.2	18362.4

APPENDIX C

KC-135A/LORING AFB, SEYMOUR-JOHNSON AFB, AND CASTLE AFB BASELINE LCOM FAILURE CLOCK WORKSHEETS

TABLE C1-1

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR LORING AFB

EQUIPMENT SUBSYSTEM	WUC	F- CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	TOTAL MAD PER BASE PER YEAR (1977) ÷	BASELINE F-CLOCK VALUE (SORTIES/ MA) =
PROPULSION	23A	FA23AS	1579	41	38.5
		FA23A0		2	789.5
	23B	FA23BS		53	29.8
	23C	FA23CS		90	17.5
	23D	FA23DS		37	42.7
	23E	FA23ES		49	32.2
	23H	FA23HS		152	10.4
	23J	FA23JS		311	5.1
		FA23J0		2	789.5
	23K	FA23KS		258	6.1
	23L	FA23LS		212	7.4
	23M	FA23MS		246	6.4
	23N	FA23NS		143	11.0
	23P	FA23PS		320	4.9
	23R	FA23RS		190	8.3
		FA23R0		32	49.3
	230	FA230S		7	225.6
FLIGHT INDICATORS	51l	FA511S	1579	143	11.0
AIR DATA SYSTEM	51B	FA51BS	1579	77	20.5
HORIZ. SITU. INDIC.	51A	FA51AS	1579	211	7.5
AUTOPILOT	521	FA521S	1579	58	27.2
		FA5210		174	9.1
UHF COMM. SET	63A 63R	FA63RS	1579	362	4.4
IFF SET	65B	FA65BS	1579	92	17.2
INS SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
INSTR. LANDING SET	71B	FA71BS	1579	73	21.6
TACAN SET	71C	FA71CS	1579	212	7.4
A-H REF. SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
RADAR SET	72B	FA72BS	1579	549	2.3
FUSELAGE RADOME WINDSHIELD	111 111J 114H	FA1115	1579	373	4.2

TABLE C1-2

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR LORING AFB

EQUIPMENT SUBSYSTEM	WUC	F-CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	÷ TOTAL MAD PER BASE PER YEAR (1977)	= BASELINE F-CLOCK VALUE (SORTIES/ MA)
WINGS	11A 11J 11K 116 117	FA11A0 FA11J0 FA11K0 FA116S FA1160 FA117S FA1170	1579	75 204 197 12 24 13 38	21.1 7.7 8.0 131.6 65.8 121.5 41.6
COCKPIT FURNISHINGS	12A	FA12AS FA12A0	1579	19 10	83.1 157.9
MAIN LANDING GEAR	13A	FA13A0	1579	525	3.0
BRAKES	13C	FA13CS	1579	337	4.7
STABILATOR	11G	FA11G0	1579	67	23.6
RUDDER	14B	FA14B0	1579	177	8.9
FLAPS	14E	FA14E0	1579	520	3.0
ENVIRON. CONT. SYS.	412	FA412S FA4120	1579	41 28	38.5 56.4
ELECT. PWR. GEN.	421	FA421S	1579	355	4.4
EXTERIOR LIGHTS	442	(NOT IN	MODEL)		
HYDR. PWR. SYS.	451	FA451S	1579	501	3.2
INTERNAL FUEL TANKS MAIN TANKS 1 & 2 MAIN TANKS 3 & 4 L&R WING CNTR. TANKS	 461 462 463	 FA461S FA4620 FA4630	 1579	 132 148 70	 12.0 10.7 22.6
LIQUID OXYGEN SYS. OXYGEN REG LOX CONVERTER	471 47131 47111	FA471S	1579	118	13.4
FIRE DETECTION	494	FA494S	1579	124	12.7

TABLE C2-1

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR SEYMOUR JOHNSON AFB

EQUIPMENT SUBSYSTEM	WUC	F-CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	TOTAL MAD PER BASE PER YEAR (1977) ÷	BASELINE F-CLOCK VALUE (SORTIES/ MA) =
PROPULSION	23A	FA23AS	782	27	29.0
		FA23AO		1	782.0
	23B	FA23BS		124	6.3
	23C	FA23CS		67	11.7
	23D	FA23DS		13	60.2
	23E	FA23ES		75	10.4
	23H	FA23HS		169	4.6
	23J	FA23JS		294	2.7
		FA23JO		2	391.0
	23K	FA23KS		213	3.7
	23L	FA23LS		108	7.2
	23M	FA23MS		149	5.2
	23N	FA23NS		22	35.5
	23P	FA23PS		199	3.9
	23R	FA23RS		137	5.7
		FA23RO		23	34.0
	230	FA230S		74	10.6
FLIGHT INDICATORS	511	FA511S	782	103	7.6
AIR DATA SYSTEM	51B	FA51BS	782	62	12.6
HORIZ. SITU. INDIC.	51A	FA51AS	782	124	6.3
AUTOPILOT	521	FA521S	782	19	41.2
		FA5210		58	13.5
UHF COMM. SET	63A 63R	FA63RS	782	102	7.7
IFF SET	65B	FA65BS	782	69	11.3
INS SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
INSTR. LANDING SET	71B	FA71BS	782	19	41.2
TACAN SET	71C	FA71CS	782	131	6.0
A-H REF. SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
RADAR SET	72B	FA72BS	782	351	2.2
FUSELAGE RADOME WINDSHIELD	111 111J 114H	FA111S	782	117	6.7

TABLE C2-2

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR SEYMOUR JOHNSON AFB

EQUIPMENT SUBSYSTEM	WUC	F-CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	÷ TOTAL MAD PER BASE PER YEAR (1977)	= BASELINE F-CLOCK VALUE (SORTIES/MA)
WINGS	11A 11J 11K 116 117	FA11A0 FA11J0 FA11K0 FA116S FA1160 FA117S FA1170	782	46 255 278 6 11 5 14	17.0 3.1 2.8 130.3 71.1 156.4 55.9
COCKPIT FURNISHINGS	12A	FA12AS FA12A0	782	11 5	71.1 156.4
MAIN LANDING GEAR	13A	FA13A0	782	239	3.3
BRAKES	13C	FA13CS	782	73	10.7
STABILATOR	11G	FA11G0	782	13	60.2
RUDDER	14B	FA14B0	782	32	24.4
FLAPS	14E	FA14E0	782	164	4.8
ENVIRON. CONT. SYS.	412	FA412S FA4120	782	24 16	32.6 48.9
ELECT. PWR. GEN.	421	FA421S	782	276	2.8
EXTERIOR LIGHTS	442	(NOT IN	MODEL)		
HYDR. PWR. SYS.	451	FA451S	782	139	5.6
INTERNAL FUEL TANKS MAIN TANKS 1 & 2 MAIN TANKS 3 & 4 L&R WING CNTR. TANKS	 461 462 463	 FA461S FA4620 FA4630	 782	 25 20 11	 31.3 39.1 71.1
LIQUID OXYGEN SYS. OXYGEN REG LOX CONVERTER	471 47131 47111	FA471S	782	69	11.3
FIRE DETECTION	494	FA494S	782	69	11.3

TABLE C3-1

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR CASTLE AFB

EQUIPMENT SUBSYSTEM	WUC	F-CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	÷ TOTAL MAD PER BASE PER YEAR (1977)	= BASELINE F-CLOCK VALUE (SORTIES/MA)
PROPULSION	23A	FA23AS	3043	107	28.4
		FA23AO		5	608.6
	23B	FA23BS		375	8.1
	23C	FA23CS		164	18.6
	23D	FA23DS		58	52.5
	23E	FA23ES		329	9.2
	23H	FA23HS		384	7.9
	23J	FA23JS		641	4.7
		FA23JO		5	608.6
	23K	FA23KS		500	6.1
	23L	FA23LS		325	9.4
	23M	FA23MS		832	3.7
	23N	FA23NS		270	11.3
	23P	FA23PS		584	5.2
	23R	FA23RS		436	7.0
		FA23RO		72	42.3
	230	FA230S		60	50.7
FLIGHT INDICATORS	511	FA511S	3043	400	7.6
AIR DATA SYSTEM	51B	FA51BS	3043	221	13.8
HORIZ. SITU. INDIC.	51A	FA51AS	3043	736	4.1
AUTOPILOT	521	FA521S	3043	116	26.2
		FA521O		347	8.8
UHF COMM. SET	63A	FA63RS	3043	390	7.8
	63R				
IFF SET	65B	FA65BS	3043	199	15.3
INS SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
INSTR. LANDING SET	71B	FA71BS	3043	111	27.4
TACAN SET	71C	FA71CS	3043	296	10.3
A-H REF. SET	(NOT	INSTALLED	IN SAMPLE	KC-135A)	
RADAR SET	72B	FA72BS	3043	1048	2.9
FUSELAGE	111	FA111S	3043	417	7.3
RADOME	111J				
WINDSHIELD	114H				

TABLE C3-2

KC-135A BASELINE LCOM F-CLOCK CALCULATIONS FOR CASTLE AFB

EQUIPMENT SUBSYSTEM	WUC	F-CLOCK ID	TOTAL SORTIES PER BASE PER YEAR (1977)	TOTAL MAD PER BASE PER YEAR (1977) ÷	BASELINE F-CLOCK VALUE (SORTIES/ MA) =
WINGS	11A	FA11A0	3043	162	18.8
	11J	FA11J0		341	8.9
	11K	FA11K0		256	11.9
	116	FA116S		35	86.9
		FA1160		70	43.5
	117	FA117S		21	144.9
		FA1170		63	48.3
COCKPIT FURNISHINGS	12A	FA12AS	3043	22	138.3
		FA12A0		11	276.6
MAIN LANDING GEAR	13A	FA13A0	3043	1232	2.5
BRAKES	13C	FA13CS	3043	566	5.4
STABILATOR	11G	FA11F0	3043	57	53.4
RUDDER	14B	FA14B0	3043	215	14.2
FLAPS	14E	FA14E0	3043	509	6.0
ENVIRON. CONT. SYS.	412	FA412S	3043	98	31.1
		FA4120		66	46.1
ELECT. PWR. GEN.	421	FA421S	3043	732	4.2
EXTERIOR LIGHTS	442	(NOT IN	MODEL)		
HYDR. PWR. SYS.	451	FA451S	3043	822	3.7
INTERNAL FUEL TANKS					
MAIN TANKS 1 & 2	461	FA461S	3043	209	14.6
MAIN TANKS 3 & 4	462	FA4620		239	12.7
L&R WING CNTR. TANKS	463	FA4630		173	17.6
LIQUID OXYGEN SYS	471	FA471S	3043	211	14.4
OXYGEN REG.	47131				
LOX CONVERTER	47111				
FIRE DETECTION	494	FA494S	3043	419	7.3

APPENDIX D

KC-135A/LORING LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEETS

TABLE DL1-1---4 Calculation of Actual Maintenance Action Demands

TABLE DL2-1---4 Calculation of Estimated Maintenance Action Demands and Metrics-Model-Adjusted F-Clock Values

KC-135A/SEYMOUR-JOHNSON LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEETS

TABLE DS1-1---4 Calculation of Actual Maintenance Action Demands

TABLE DS2-1---4 Calculation of Estimated Maintenance Action Demands and Metrics-Model-Adjusted F-Clock Values

KC-135A/CASTLE LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEETS

TABLE DC1-1---4 Calculation of Actual Maintenance Action Demands

TABLE DC2-1---4 Calculation of Estimated Maintenance Action Demands and Metrics-Model-Adjusted F-Clock Values

KC-135A/LORING AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL1-1 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R	+ LCOM M	+ LCOM H	= TOTAL MAD PER BASE PER YR.	÷ NO. U.E.	= AMAD	PARTIAL AMAD (MODEL WUC's)
PROPULSION	23X	----	23X	---	---	---	2188	26	84.2	84.2
		FA23AS	23A	4	39	0	43(41)		1.6	
		FA23AO	---	---	---	---	---(2)		0.1	
		FA23BS	23B	0	53	0	53		2.0	
		FA23CS	23C	4	86	0	90		3.5	
		FA23DS	23D	3	34	0	37		1.4	
		FA23ES	23E	5	44	0	49		1.9	
		FA23HS	23H	21	131	0	152		5.8	
		FA23JS	23J	41	270	2	313(311)		12.0	
		FA23JO	---	---	---	---	---(2)		0.1	
		FA23KS	23K	90	165	3	258		9.9	
		FA23LS	23L	43	165	4	212		8.2	
		FA23MS	23M	110	122	14	246		9.5	
		FA23NS	23N	44	80	19	143		5.5	
		FA23PS	23P	33	286	1	320		12.3	
		FA23RS	23R	65	151	6	222(190)		7.3	
		FA23RO	---	---	---	---	---(32)		1.2	
		FA230S	230	7	0	0	7		0.3	
			Other	7	36	0	43		1.7	
FLIGHT INDICATORS	511XX	FA511S	511	72	61	10	143	26	5.5	10/26 = 0.4
			51116	0	2	0	2			
			51132	1	6	1	8			
AIR DATA SYSTEM	51BX	FA51BS	51B	37	21	19	77	26	3.0	30/26 = 1.2
			51BA	5	3	0	8			
			51BE	12	8	2	22			
HORIZONTAL SITUATION INDICATOR	51AXX	FA51AS	51A	98	64	49	211	26	8.1	24/26 = 0.9
			51AAD	0	5	5	10			
			51AC	6	3	1	10			
			51AD	3	1	0	4			

KC-135A/LORING AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL1-2 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R	+ LCOM M	+ LCOM H	= TOTAL MAD PER BASE PER YR.	÷ NO. U.E.	= AMAD	PARTIAL AMAD (MODEL WUC's)
AUTOPILOT	521XX	FA521S FA5210	521 52111 52113 52141 52121 52122 52123	153 33 37 0 21 0 3	42 5 1 0 1 9 0	37 0 0 0 0 1 0	232(58) 38(174) 38 0 22 10 3	26	2.2 6.7	111/26 = 4.3
UHF COMMUNICATIONS SET	63AX	FA63RS	63A/63R 63AF 63AH	201 180 14	73 48 10	88 20 2	362 248 26	26	13.9	274/26 = 10.5
IFF TRANSPONDER SET	65BXX	FA65BS	65B 65BAA 65BBB	59 41 14	13 3 2	20 1 0	92 45 16	26	3.5	61/26 = 2.3
INS SET			(NOT	INSTALLED IN SAMPLE KC-135A)						
INSTRUMENT LANDING SET	71BXX	FA71BS	71B 71BCF 71AAA	40 4 2	7 0 0	26 0 0	73 4 2	26	2.8	6/26 = 0.2
TACAN SET	71CX	FA71CS	71C 71CA	167 150	28 14	17 1	212 165	26	8.2	165/26 = 6.3
A-H REFERENCE SET			(NOT INSTALLED IN SAMPLE KC-135A)							
RADAR SET	72BXX	FA72BS	72B 72BDA 72BFA	286 115 117	149 28 47	114 1 1	549 144 167	26	21.1	311/26 = 12.0
FUSELAGE RADOME WINDSHIELD	111XX	FA111S	111 1111J 1114H	62 0 0	179 9 1	132 0 0	373 9 1	26	14.3	10/26 = 0.4

KC-135A/LORING AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL1-3 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R	+ LCOM M	+ LCOM H	= TOTAL MAD PER BASE PER YR.	÷ NO. U.E.	= AMAD	PARTIAL AMAD (MODEL WUC's)
WINGS	11X	---	11X	---	---	---	567	26	21.8	563/26 = 21.7
		FA11AO	11A	2	71	2	75		2.9	
		FA11JO	11J	10	191	3	204		7.8	
		FA11KO	11K	1	196	0	197		7.6	
		FA11GS	116	0	36	0	36(12)		0.5	
		FA1160	---	---	---	---	---(24)		0.9	
		FA117S	117	2	49	0	51(13)		0.5	
		FA1170	---	---	---	---	---(38)		1.5	
COCKPIT FURNISHINGS	12AXX	FA12AS	12A	2	24	3	29(19)	26	0.7	10/26 = 0.4
		FA12AO	12AAO	0	8	2	10(10)		0.4	
MAIN LANDING GEAR	13AXX	FA13AO	13A	144	242	139	525	26	20.2	165/26 = 6.3
			13AMF	115	1	24	140			
			13AMG	15	7	3	25			
BRAKES	13CX	FA13CS	13C	242	31	64	332	26	13.0	206/26 = 7.9
			13CA	151	11	44	206			
STABILATOR	11G	FA11GO	11G	2	63	2	67	26	2.6	2.6
RUDDER	14BX	FA14BO	14B	34	65	78	177	26	6.8	17/26 = 0.7
			14BF	0	15	2	17			
FLAPS	14EX	FA14EO	14E	36	314	170	520	26	20.0	125/26 = 4.8
			14EF	3	61	3	67			
			14EG	3	55	0	58			
ENVIRONMENTAL CONTROL SYSTEM	412XX	FA412S	412	27	40	2	69(41)	26	1.6	3/26 = 0.1
		FA4120	41214	0	3	0	3(28)		1.1	
ELECTRIC POWER GENERATION	421XX	FA421S	421	127	211	17	355	26	13.7	48/26 = 1.8
			4215L	9	39	0	48			

KC-135A/LORING AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL1-4 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
EXTERIOR LIGHTS	442XX		442	38	141	48	227	26	8.7	24/26 = 0.9
ANTI-COLLISION LIGHTS		NOT	4425	3	2	0	5			
LANDING AND TAXI LIGHTS		IN	44211	2	11	0	13			
		MODEL	44212	0	6	0	6			
HYDRAULIC POWER SYSTEM	411XX	FA451S	451	87	138	276	501	26	19.3	122/26 = 4.7
			4511E	6	15	75	96			
			45118	6	9	11	26			
INTERNAL FUEL TANKS	46XXX	---	46XXX	---	---	---	444	26	17.1	17.1
MAIN TANKS 1 AND 2		FA461S	(461)	(3)	(216)	(6)	(225)		8.7	
			46130	0	17	0	17			
			46170	0	199	2	201			
MAIN TANKS 3 AND 4		FA4620	(462)	(11)	(133)	(4)	(148)		5.7	
			46210	0	106	2	108			
			46240	0	11	0	11			
LEFT & RIGHT WING CENTER TANKS		FA4630	(463)	(3)	(62)	(6)	(71)		2.7	
			46310	1	33	6	40			
			46340	1	29	0	30			
LIQUID OXYGEN SYSTEM	471XX	FA471S	471	78	39	1	118	26	4.5	2.2
OXYGEN REGULATOR			47131	18	18	0	36		1.4	
LIQUID OXYGEN CONVERTER			47111	14	8	0	22		0.8	
FIRE DETECTION SYSTEM	494XX	FA494S	494	21	98	5	124	26	4.8	74/26 = 2.8
			49421	13	58	3	74			

KC-135A/LORING AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL2-1 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7) =	PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD	PRESENT F-CLOCK VALUE *	METRIC MODEL ADJUSTED F-CLOCK
---	-57.7	+.244	108 (P02)	+.055	432 (P04)	+.021	2900 (Ø10)	+.203	5.6 (Ø27)	-.798	6.0 (Ø32)	+7.51	4.8 (Ø33)	---	---	85.7	1.00	85.7	0.98	---	---
23AS																				38.5	37.7
23AO																				789.5	773.7
23BS																				29.8	29.2
23CS																				17.5	17.2
23DS																				42.7	41.8
23ES																				32.2	31.6
23HS																				10.4	10.2
23JS																				5.1	5.0
23JO																				789.5	773.7
23KS																				6.1	6.0
23LS																				7.4	7.3
23MS																				6.4	6.3
23NS																				11.0	10.8
23PS																				4.9	4.8
23RS																				8.3	8.1
23RO																				49.3	48.3
23OS																				225.6	221.1
51TS	-4.66	+.398	1 (A03)	+.00004	3500 (Ø13)	+.002	26.7 (Ø17)	-.004	190 (E03)	+.046	110 (E19)					0.2	13.75	2.75	2.00	11.0	22.0
51BS	-1.98	+.023	2.07 (A03)	-.035	2.29 (A16)	-.001	1750 (Ø08)	+.001	3500 (Ø13)	-.071	9 (Ø23)	-.05	23 (E13)	+.063	110 (E19)	3.6	2.50	9.0	0.33	20.5	6.8
51AS	-14.29	+.751	1.5 (A07)	+1.003	2.0 (A16)	-.05	128 (Ø14)	+3.02	5 (Ø33)	+.177	25 (E20)					1.5	9.00	13.5	0.60	7.5	4.5
52TS	+21.94	-.48	18.14 (A03)	+.016	976.1 (A04)	-1.50	6.01 (A13)	-.26	85 (A19)	-.0004	1750 (Ø08)	+.64	9 (Ø23)	+.02	186 (E18)	5.8	2.07	12.0	0.74	27.2	20.1
52TO																				9.1	6.7
63RS	-2.36	0.26	23 (E13)	-.09	186 (E18)	+.118	110 (E19)	-.04	181 (E27)	+7.46	2.69 (E30)					1.13	1.32	1.49	9.32	4.4	41.0
				(ENVIRONMENTAL MODEL)																	

KC-135A/LORING AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL2-2 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A	+ (B1	* X1)	+ (B2	* X2)	+ (B3	* X3)	+ (B4	* X4)	+ (B5	* X5)	+ (B6	* X6)	+ (B7	* X7)	= PEMAD	* AMAD/PAMAD	= TOTAL EMAD	AMAD/EMAD	PRESENT F-CLOCK VALUE	* METRIC MODEL ADJUSTED F-CLOCK
65BS	+.890	+.602	1 (A02)	-.03	24.13 (A09)	-.813	0.9 (Ø30)	+.008	146 (E09)							1.3	1.52	1.98	1.77	17.2	30.4
					NOT	IN KC-135A															
71BS	-1.13	+.03	47 (A06)	+.004	266.7 (Ø15)	-.007	5.6 (Ø27)	-.025	25 (E20)							0.45	14.00	6.2	0.45	21.6	9.7
71CS	-1.84	+.06	45 (A03)	-.044	20 (A18)	+.099	6 (Ø32)	+.006	190 (E03)	-.017	146 (E09)	+.142	25 (E20)			2.8	1.30	3.64	2.25	7.4	16.6
					NOT	IN KC-135A															
72BS	-163.5	-7.70	2.14 (A02)	+.21	4 (A12)	+2.02	87 (A19)	+.001	4000 (Ø11)	+.271	23 (E13)	+.138	25 (E20)			11.2	1.76	19.7	1.07	2.3	2.5
11TS	-2.30	+.06	1 (F08)	+.027	150 (Ø05)	+.013	15.8 (Ø21)	-.078	25 (E20)							0.12	35.75	69.4	0.21	4.2	0.9
	+18.24	-.099	100 (F07)	-.005	266.7 (Ø15)	+.031	15.8 (Ø21)	-.037	5.6 (Ø27)	-.029	186 (E18)					1.82					
---	-27.4	+.021	1156.7 (F04)	-.006	1750 (Ø08)	+.503	115 (Ø12)	-.096	127.5 (Ø14)	+.016	15.8 (Ø21)	-.334	23 (E13)	+.244	25 (E20)	29.3	1.00	29.3	0.74	---	---
11AO																				21.1	15.6
11JO																				7.7	5.7
11KO																				8.0	5.9
116S																				131.6	97.4
1160																				65.8	48.7
117S																				121.5	89.9
1170																				41.6	30.8
12AS	-3.10	+.022	110 (E19)	+.462	25 (E20)											0.44	2.75	1.21	0.91	83.1	75.6
12AO					ENV	IRONMENTAL		MODEL												157.9	143.7
13AO	-3.82	+.001	2960 (F03)	+1.16	1 (F06)	+1.74	1.3 (F13)	+.039	127.5 (Ø14)	+.01	157.5 (Ø19)					10.0	3.21	32.1	0.63	3.0	1.9

KC-135A/LORING AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL2-3 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7) =	PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
13CS	+.030	-.003	190 (E03)	+.007	315 (E16)	ENVIRONMENTAL MODEL										1.65	1.65	2.72	4.78	4.7	22.4
11G0	-2.47	+.002	1600 (F03)	+.862	5 (F06)	+.01	15.8 (Ø21)	-.09	25 (E20)							3.6	1.00	3.6	0.72	23.6	17.0
14B0	-2.68	+.002	190 (E03)	-.004	146 (E09)	+.01	243 (E18)	+.06	16.5 (E24)							0.65	9.71	6.31	1.08	8.9	9.6
						ENVIRONMENTAL MODEL															
14E0	+13.2	-.031	266.7 (Ø15)	+.185	15.8 (Ø21)	-.21	5.6 (Ø27)									6.6	4.17	27.52	0.73	3.0	2.2
						OPERATIONS MODEL															
412S 4120	-.052	+.12	1 (F08)			EQUIPMENT MODEL										0.07	27.0	1.89	1.43	38.5 56.4	55.0 80.7
421S	-1.29	+.90	0.48 (F13)	+.02	82 (Ø07)											0.62	7.61	4.7	2.9	4.4	12.8
NOT IN MODEL																					
451S	+.156	-.02	114 (E06)	+.252	20.6 (E08)	ENVIRONMENTAL MODEL										3.35	4.11	13.77	1.40	3.2	4.5
---	+5.03	+.01	315 (E16)	-.027	186 (E18)	+.04	110 (E19)	-.06	39.25 (E23)							4.18	1.0	4.18	4.09	---	
4620 4630						ENVIRONMENTAL MODEL														12.0 22.6	49.1 92.5

KC-135A/LORING AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DL2-4 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7) =	PEMAD *	AMAD/PAMAD =	TOTAL EMAD	AMAD/EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
471S	+5.48	-.12	3 (F03)	-.36	0.9 (Ø30)	+.04	114 (E06)	+.03	160.5 (E07)	+.18	3 (E21)	-.08	16.5 (E24)	-.07	181 (E27)	0.74	2.05	2.41	1.86	13.4	24.9
	-2.43	+.06	4 (F08)	+.02	150 (Ø05)	-.000	19500 (Ø06)	+.17	4.8 (Ø33)							0.44					
																1.18					
494S	-.254	+.001	315 (E16)	+.003	110 (E19)	-.002	16.50 (E24)									0.19	1.71	0.32	14.77	12.7	187.6
						ENVIRONMENTAL MODEL															

KC-135A/SEYMOUR JOHNSON AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS1-1 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR						PARTIAL AMAD (MODEL WUC's)
				LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	
PROPULSTION	23X	---	23X	---	---	---	1709	13	131.5	131.5
		FA23AS	23A	2	18	8	28			
		FA23AO	---	---	---	---	---			
		FA23BS	23B	0	122	2	124			
		FA23CS	23C	0	35	32	67			
		FA23DS	23D	1	7	5	13			
		FA23ES	23E	1	72	2	75			
		FA23HS	23H	12	116	41	169			
		FA23JS	23J	33	198	65	296			
		FA23JO	---	---	---	---	---			
		FA23KS	23K	35	175	3	213			
		FA23LS	23L	23	70	15	108			
		FA23MS	23M	53	89	7	149			
		FA23NS	23N	1	19	2	22			
		FA23PS	23P	5	193	1	199			
		FA23RS	23R	44	96	20	160			
		FA23RO	---	---	---	---	---			
		FA230S	230	6	1	67	74			
			Other	5	1	6	12			
FLIGHT INDICATORS	511XX	FA511S	511	56	44	3	103	13	7.9	11/13 = 0.85
			51116	4	2	1	7			
			51132	1	3	0	4			
AIR DATA SYSTEM	51BX	FA51BS	51B	25	30	7	62	13	4.8	24/13 = 1.85
			51BA	0	9	0	9			
			51BE	7	8	0	15			
HORIZONTAL SITUATION INDICATOR	51AXXX	FA51AS	51A	67	39	18	124	13	9.5	37/13 = 2.85
			51AAD	16	3	3	22			
			51AC	8	0	1	9			
			51AD	4	2	0	6			

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS1-2 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
AUTOPILOT	521XX	FA521S FA5210	521 52111 52113 52141 52121 52122 52123	50 16 10 8 3 2 0	9 0 0 0 0 0 0	18 0 0 0 0 0 0	77 16 10 8 3 2 0	13	5.9	39/13 = 3.0
UHF COMMUNICATIONS SET	63AX	FA63RS	63A/63R 63AF 63AH	53 44 2	29 13 3	20 3 0	102 60 5	13	7.85	65/13 = 5.0
IFF TRANSPONDER SET	65BXX	FA65BS	65B 65BAA 65BBB	33 23 7	8 2 3	28 2 6	69 27 16	13	5.3	43/13 = 3.3
INS SET			(NOT INSTALLED IN SAMPLE KC-135A)							
INSTRUMENT LANDING SET	71BXX	FA71BS	71B 71BCF 71AAA	6 1 3	5 1 2	8 0 0	19 2 5	13	1.5	7/13 = 0.5
TACAN SET	71CX	FA71CS	71C 71CS	82 71	35 15	14 4	131 90	13	10.1	90/13 = 6.9
A-H REFERENCE SET			(NOT INSTALLED IN SAMPLE KC-135A)							
RADAR SET	72BXX	FA72BS	72B 72BDA 72BFA	174 76 49	114 13 33	63 1 4	351 90 86	13	27.0	176/13 = 13.5
FUSELAGE RADOME WINDSHIELD	111XX	FA111S	111 1111J 1114H	23 0 2	86 6 20	8 0 3	117 6 25	13	9.0	31/13 = 2.4

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS1-3 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
WINGS	11X	----	11X	---	---	---	617	13	47.5	615/13 = 47.3
		FA11AO	11A	2	44	0	46			
		FA11JO	11J	5	247	3	255			
		FA11KO	11K	6	271	1	278			
		FA116S	11G	1	16	0	17			
		FA1160	---	---	---	---	---			
		FA117S	117	2	17	0	19			
		FA1170	---	---	---	---	---			
COCKPIT FURNISHINGS	12AXX	FA12AS	12A	4	12	0	16	13	1.2	13/13 = 1.0
		FA12AO	12AAO	3	10	0	13			
MAIN LANDING GEAR	13AXX	FA13AO	13A	85	127	27	239	13	18.4	122/13 = 9.4
			13AMF	64	3	25	92			
			13AMG	8	22	0	30			
BRAKES	13CX	FA13CS	13C	35	32	6	73	13	5.6	42/13 = 3.2
			13CA	26	11	5	42			
STABILATOR	11G	FA11GO	11G	0	13	0	13	13	1.0	1.0
RUDDER	14BX	FA14BO	14B	11	16	5	32	13	2.5	1/13 = 0.1
			14BF	0	1	0	1			
FLAPS	14EX	FA14EO	14E	13	147	4	164	13	12.6	78/13 = 6.0
			14EF	2	28	2	32			
			14EG	3	42	1	46			
ENVIRONMENTAL CONTROL SYSTEM	412XX	FA412S	412	21	15	4	40	13	3.1	5/13 = 0.4
			41214	2	3	0	5			

KC-135A/SEYMOUR JOHNSON AFB LCOM

FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS1-4 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R	+ LCOM M	+ LCOM H	= TOTAL MAD PER BASE PER YR.	÷ NO. U.E.	= AMAD	PARTIAL AMAD (MODEL WUC's)
ELECTRIC POWER GENERATION	421XX	FA421S	421	74	176	26	276	13	21.2	31/13 = 2.4
			4215L	13	18	0	31			
EXTERIOR LIGHTS	442XX		442							
ANTI-COLLISION LIGHTS		NOT	4425							
LANDING AND TAXI LIGHTS		IN	44211		NOT IN MODEL					
		MODEL	44212							
HYDRAULIC POWER SYSTEM	451XX	FA451S	451	46	84	9	139	13	10.6	20/13 = 1.5
			4511E	2	4	2	8			
			45118	8	3	1	12			
INTERNAL FUEL TANKS	46XXX	----	46XXX	---	---	---	56	13	4.3	4.3
MAIN TANKS 1 and 2		FA461S	(461)	(9)	(16)	(0)	(25)			
			46130	0	0	0	0			
			46170	0	1	0	1			
MAIN TANKS 3 and 4		FA4620	(462)	(9)	(9)	(2)	(20)			
			46210	0	2	0	2			
			46240	0	1	0	1			
LEFT & RIGHT WING CENTER TANKS		FA4630	(463)	(6)	(4)	(1)	(11)			
			46310	0	2	0	2			
			46340	0	0	0	0			
LIQUID OXYGEN SYSTEM	471XX	FA471S	471	50	17	2	69	13	5.3	49/13 = 3.8
OXYGEN REGULATOR			47131	39	8	0	47			
LIQUID OXYGEN CONVERTER			47111	0	2	0	2			
FIRE DETECTION SYSTEM	494XX	FA494S	494	14	53	2	69	13	5.3	42/13 = 3.2
			49421	9	32	1	42			

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS2-1 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL)																				
LCOM F-CLOCK	A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7) =	PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
---	-57.68	+.24	52 (P02)	+.06	432 (P04)	+.02	2900 (Ø10)	+.20	6.20 (Ø27)	-.80	6 (Ø32)	+7.51	5 (Ø33)	--	--	73.7	1.0	73.7	131.5	---	
23AS																				29.0	51.7
23AO																				782.0	1395.3
23BS																				6.3	11.2
23CS																				11.7	20.9
23DS																				60.2	107.4
23ES																				10.4	18.6
23HS																				4.6	8.2
23JS																				2.7	4.8
23JO																				391.0	697.6
23KS																				3.7	6.2
23LS																				7.2	12.8
23MS																				5.2	9.3
23NS																				35.5	63.3
23PS																				3.9	7.0
23RS																				5.7	10.2
23RO																				34.0	60.7
23OS																				10.6	18.9
51TS	-7.60	-.01	80 (E03)	+.10	88 (E19)											0.53	9.3	4.93	1.60	7.6	12.2
						ENVIRONMENTAL MODEL															
51BS	-1.98	+.02	2.07 (A03)	-.04	2.29 (A16)	-.001	1750 (Ø08)	+.001	3500 (Ø13)	-.07	4 (Ø23)	-.05	57 (E13)	+.06	88 (E19)	1.6	2.6	4.16	1.2	12.6	14.5
51AS	-14.29	+.75	1.49 (A07)	+1.00	2.02 (A16)	-.05	127.5 (Ø14)	+3.02	5 (Ø33)	+.18	17 (E20)					0.7	3.33	2.33	4.08	6.3	25.7
52TS	+21.94	-.48	18.14 (A03)	+.016	976.09 (A04)	-1.50	6.01 (A13)	-.26	85 (A19)	-.000	1750 (Ø08)	+.64	9 (Ø23)	+.02	215 (E18)	6.3	1.97	12.4	.475	41.2	19.6
5210																				13.5	6.4

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS2-2 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL)																				
LCOM F-CLOCK	A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7)	= PEMAD *	AMAD/PAMAD =	TOTAL EMAD	AMAD/EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
63RS	-3.13	+3.42	41.65 (A03)	-.08	1583.9 (A04)	-1.56	6.52 (A05)									0.75	1.57	1.18	6.67	7.7	51.3
						EQUIPMENT	MODEL														
65BS	+.89	+.60	1 (A02)	-.03	24.13 (A09)	-.81	0.9 (Ø30)	+.008	144 (E09)							1.3	1.61	2.1	2.53	11.3	28.6
NOT IN KC-135A																					
71BS	-1.13	+.03	47 (A06)	+.004	305.20 (Ø15)	-.007	6.20 (Ø27)	-.03	17 (E20)							0.8	3.0	2.4	0.625	41.2	25.7
71CS	-1.84	+.06	45 (A03)	-.04	20 (A18)	+.099	6 (Ø32)	+.006	80 (E03)	-.02	144 (E09)	+.142	17 (E20)			1.05	1.46	1.56	6.59	6.0	39.5
NOT IN KC-135A																					
72BS	-163.5	-7.70	2.14 (A02)	+.21	4 (A12)	+2.02	87 (A19)	+.001	4000 (Ø11)	+.27	57 (E13)	+.14	17 (E20)			19.3	2.0	38.6	0.699	2.2	1.5
111S	-2.30	+.06	1 (F08)	+.027	150 (Ø05)	+.013	18.70 (Ø21)	-.08	17 (E20)							0.8	3.75	6.15	1.46	6.7	9.8
	+18.24	-.099	100 (F07)	-.005	305.20	+.03	18.70 (Ø21)	-.04	6.20 (Ø27)	-.03	215 (E18)					0.84					
---	-27.4	+.021	1156.7 (F04)	-.006	1750 (Ø08)	+.50	115 (Ø12)	-.096	127.5 (Ø14)	+.016	18.70 (Ø21)	-.33	57 (E13)	+.24	17 (E20)	16.3	1.00	16.3	47.5	---	
11A0																			2.9	17.0	49.5
11J0																				3.1	9.0
11K0																				2.8	8.2
116S																				130.3	379.7
1160																				71.1	207.2
117S																				156.4	455.8
1170																				55.9	162.9

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS2-3 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A	+ (B1	* X1)	+ (B2	* X2)	+ (B3	* X3)	+ (B4	* X4)	+ (B5	* X5)	+ (B6	* X6)	+ (B7	* X7)	= PEMAD	* AMAD/PAMAD	= TOTAL EMAD	AMAD/EMAD	* PRESENT F-CLOCK VALUE	= METRIC MODEL • ADJUSTED F-CLOCK
12AS 12AO	-4.638	10.00	1750 (Ø08)	+.05	115 (Ø12)	+.009	30.50 (Ø17)	10.02	18.70 (Ø21)	-.01	61.50 (Ø25)	-.05	6.20 (Ø27)	-.025	88 (E19)	0.353	1.2	0.424	1.2 2.83	71.1 156.4	201.4 443.1
13AO	-3.82	+.001	2960 (F03)	+1.2	1 (F06)	+1.74	1.3 (F13)	+.04	127.5 (Ø14)	+.01	186.60 (Ø19)					10.3	1.96	20.19	18.4 0.911	3.3	3.0
13CS	-31.32	+.13	90 (F09)	+2.0	1.2 (Ø03)	+.19	150 (Ø05)	+.007	52.3 (Ø26)	-.002	5200 (Ø31)	-.01	80 (E03)			2.4	1.75	3.75	5.6	10.7	16.8
11GO	-2.47	+.002	1600 (F03)	+.86	5 (F06)	+.01	18.70 (Ø21)	-.09	17 (E20)							4.3	1.0	4.3	1.0 0.233	60.2	14.0
14BO	-.434	+.004	305.2 (Ø15)	-.002	30.5 (Ø17)	-.62 OPERATIONS	0.08 (Ø34)	MODEL								0.66	25.0	16.5	0.15	24.4	3.7
14EO	+13.19	-.031	305.2 (Ø15)	+.19	18.7 (Ø21)	-.21 OPERATIONS	6.2 (Ø27)	MODEL								5.80	2.1	12.18	1.03	4.8	5.0
41ZS 4120	-.052	+.120	1 (F08)			EQUIPMENT	MODEL									0.07	7.75	0.54	5.71	32.6 48.9	186.3 279.2
42TS	-1.29	+.904	0.48 (F13)	+.02	82 (Ø07)											0.62	8.83	5.47	21.2 3.87	2.8	10.8
NOT IN MODEL																					
45TS	-1.75	+.02	150 (Ø05)	+.0001	9500 (Ø06)	-.0002 OPERATIONS	1750 (Ø08)	+.002 MODEL	127.5 (Ø14)	-.18	6 (Ø32)	+.17	5 (Ø33)			1.39	7.07	9.83	1.08	5.6	6.0

KC-135A/SEYMOUR JOHNSON AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DS2-4 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7) =	PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
---																	2.44	1.0	2.44	1.76		
461S	+7.81	+.001	2900 (Ø10)	-.001	4000 (Ø11)	-.02	305.2 (Ø15)	+.015	30.5 (Ø17)	+.03	18.7 (Ø21)	-.07	6.2 (Ø27)							31.3	55.2
4620																				39.1	68.9
4630						OPERATIONS	MODEL													71.1	125.3
471S	-.02	+.37	0.9 (Ø30)													0.94 0.31	1.39	1.31	4.06	11.3	45.8
	-2.04	+.02	150 (Ø05)	-.0001	9500 (Ø06)	+.28	5 (Ø33)									0.63					
						OPERATIONS	MODEL														
494S	+.07	-.03	2.2 (F04)	+.009	9 (F08)											0.08	1.66	0.13	39.9	11.3	450.9
						EQUIPMENT	MODEL														

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC1-1 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
PROPULSION	23XXX	---	23XXX	---	---	---	5267	32	164.6	164.6
		FA23AS	23A	9	102	1	112 (107)		3.3	
		FA23AO					(5)		0.2	
		FA23BS	23B	1	370	4	375		11.7	
		FA23CS	23C	14	150	0	164		5.1	
		FA23DS	23D	4	54	0	58		1.8	
		FA23ES	23E	33	283	13	329		10.3	
		FA23HS	23H	84	294	6	384		12.0	
		FA23JS	23J	195	435	16	646 (641)		20.0	
		FA23JO					(5)		0.2	
		FA23KS	23K	139	283	78	500		15.6	
		FA23LS	23L	106	215	4	325		10.1	
		FA23MS	23M	249	331	252	832		26.0	
		FA23NS	23N	26	190	54	270		8.4	
		FA23PS	23P	85	433	66	584		18.2	
		FA23RS	23R	137	296	75	508 (436)		13.6	
		FA23RO					(72)		2.2	
		FA23OS	23O	51	9	0	60		1.9	
			Other	5	112	3	120		3.8	
FLIGHT INDICATORS	511XX	FA511S	511	234	138	28	400	32	12.5	47/32 = 1.5
			51116	12	8	0	20			
			51132	8	19	0	27			
AIR DATA SYSTEM	51BX	FA51BS	51B	99	98	24	221	32	6.9	112/32 = 3.5
			51BA	16	8	1	25			
			51BE	18	69	0	87			
HORIZONTAL SITUATION INDICATOR	51AXX	FA51AS	51A	311	225	200	736	32	23.0	160/32 = 5.0
			51AAD	77	18	2	97			
			51AC	25	13	0	38			
			51AD	12	6	7	25			

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC1-2 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
AUTOPILOT	521XX	FA521S FA5210	521 52111 52113 52141 52121 52122 52123	328 124 96 53 46 26 28	100 6 0 2 3 4 0	35 0 0 0 0 0 0	463(116) 130(347) 96 55 49 30 28	32	3.6 10.8	388/32 = 12.1
UHF COMMUNICATIONS SET	63AX	FA63RS	63A/63R 63AF 63AH	191 148 7	81 32 11	115 21 1	387 201 19	32	12.1	220/32 = 6.9
IFF TRANSPONDER SET	65BXX	FA65BS	65B 65BAA 65BBB	123 69 45	30 1 5	46 0 1	199 70 51	32	6.2	121/32 = 3.8
INS SET	(NOT	INSTALLED IN		SAMPLE	KC-135A's)					
INSTRUMENT LANDING SET	71BXX	FA71BS	71B 71BCF 71AAA	50 15 10	31 3 7	30 0 0	111 18 17	32	3.5	35/32 = 1.1
TACAN SET	71CX	FA71CS	71C 71CA	184 170	62 24	50 35	296 229	32	9.3	229/32 = 7.1
A-H REFERENCE SET	(NOT	INSTALLED IN		KC-135A)						
RADAR SET	72BXX	FA72BS	72B 72BDA 72BFA	523 181 155	380 49 86	145 0 3	1048 230 244	32	32.8	474/32 = 14.8

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC1-3 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

				ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR						
EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	LCOM R +	LCOM M +	LCOM H =	TOTAL MAD PER BASE PER YR. ÷	NO. U.E. =	AMAD	PARTIAL AMAD (MODEL WUC's)
FUSELAGE RADOME WINDSHIELD	111XX	FA111S	111 1111J 1114H	81 0 0	179 24 24	157 0 52	417 24 76	32	13.0	100/32 = 3.1
WINGS	11X	---- FA11A0 FA11J0 FA11K0 FA116S FA1160 FA117S FA1170	11X 11A 11J 11K 116 117	--- 0 14 2 0 0	--- 149 288 246 104 82	--- 13 39 8 1 2	948 162 341 256 105 (35) (70) 84 (21) (63)	32	29.6	29.6
COCKPIT FURNISHINGS SEATS	12AXX	FA12AS FA12A0	12A 12AA0	6 4	26 15	1 1	33(22) 20(11)	32	20/32	
MAIN LANDING GEAR	13AXX	FA13A0	13A 13AMF 13AMG	312 274 17	329 10 26	591 425 28	1232 709 71	32	38.5	780/32 = 24.4
BRAKES	13CX	FA13CS	13C 13CA	111 88	75 43	380 284	566 415	32	17.7	415/32 = 13.0
STABILATOR	11G	FA11G0	11G	0	53	4	57	32	1.8	1.8
RUDDER	14BX	FA14B0	14B 14BF	31 0	99 17	85 4	215 21	32	6.7	21/32 = 0.7
FLAPS	14EX	FA14E0	14E 14EF 14EG	35 8 7	284 71 65	190 33 19	509 112 91	32	15.9	203/32 = 6.3
ENVIRONMENTAL CONTROL SYSTEM WATER SEPARATOR	412XX	FA412S FA4120	412 41214	93 0	50 2	21 0	164(98) 2(66)	32	5.1	2/32 = 0.1

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC1-4 CALCULATION OF ACTUAL MAINTENANCE ACTION DEMANDS

EQUIPMENT SUBSYSTEM	SUBSYSTEM WUC	LCOM F-CLOCK	MAINT. METRIC MODEL WUC's	ACTUAL MAINT. ACTION DEMAND PER UNIT EQUIP. PER YEAR: LCOM R	+ LCOM M	+ LCOM H	= TOTAL MAD PER BASE PER YR.	÷ NO. U.E.	= AMAD	PARTIAL AMAD (MODEL WUC's)
ELECTRIC POWER GENERATION	421XX	FA421S	421	248	363	121	732	32	22.9	61/32 = 1.9
GENERATOR			4215L	37	19	5	61			
EXTERIOR LIGHTS SYSTEM	442XX	Not in Model	442	38	249	78	365	32	11.4	
ANTI-COLLISION LIGHTS			4425	1	11	6	18		0.6	0.6
LANDING LIGHTS			44211	4	25	0	29			
TAXI LIGHTS			44212	0	15	1	16			
							45		1.4	1.4
HYDRAULIC POWER SYSTEM PUMPS	451XX	FA451S	451	148	362	312	822	32	25.7	254/32 = 7.9
			4511E	13	27	26	66			
			45118	27	76	85	188			
INTERNAL FUEL TANKS	46XXX	----	46XXX				621	32	19.4	19.4
	461XX	FA461S	(461)	(11)	(184)	(14)	(209)		6.5	
MAIN TANK #1			46130	2	31	2	35			
MAIN TANK #2			46170	1	127	2	130			
	462XX	FA4620	(462)	(7)	(221)	(11)	(239)		7.5	
MAIN TANK #3			46210	1	155	7	163			
MAIN TANK #4			46240	0	59	2	61			
	463XX	FA4530	(463)	(6)	(153)	(14)	(173)		5.4	
LEFT WING CENTER TANK			46310	1	74	2	77			
RIGHT WING CENTER TANK			46340	1	77	3	81			
BREATHING OXYGEN SUPPLY	471XX	FA471S	471	93	93	25	211	32	6.6	134/32 = 4.2
OXYGEN REGULATOR			47131	58	58	9	125		3.9	
LIQUID OXYGEN CONVERTER			47111	4	4	1	9		0.3	
FIRE DETECTION SYSTEM DETECTOR	494XX	FA494S	494	94	250	75	419	32	13.1	267/32 = 8.3
			49421	78	125	64	267			

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC2-1 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7)	= PEMAD *	AMAD/PAMAD =	TOTAL EMAD	AMAD/EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL)																				
---	-57.68	+.244	124 (P02)	+.055	432 (P04)	+.021	2900 (Ø10)	+.203	10.3 (Ø27)	-.798	6.0 (Ø32)	+7.51	5.9 (Ø33)	---	---	98.9	1.00	98.9	1.67	----	----
23AS																				28.4	47.4
23AO																				608.6	1016.4
23BS																				8.1	13.5
23CS																				18.6	31.1
23DS																				52.5	87.7
23ES																				9.2	15.4
23HS																				7.9	13.2
23JS																				4.7	7.8
23JO																				608.6	1016.4
23KS																				6.1	10.2
23LS																				9.4	15.7
23MS																				3.7	6.2
23NS																				11.3	18.9
23PS																				5.2	8.7
23RS																				7.0	11.7
23RO																				42.3	70.6
23OS																				50.7	84.7
511S	-17.27	+.003	4000 (Ø11)	+.002	3500 (Ø13)	+.009	62.0 (Ø17)	+.02	103.5 (Ø25)							4.34	8.33	36.17	0.35		7.6
			OPERATIONS MODEL																		
51BS	-1.98	+.023	2.07 (A03)	-.035	2.29 (A16)	-.0008	1750 (Ø08)	+.0005	3500 (Ø13)	-.071	10 (Ø23)	-.046	3 (E13)	+.063	54 (E19)	0.9	1.97	1.77	3.89	13.8	53.7
51AS	-14.29	+.751	1.49 (A07)	+1.00	2.02 (A16)	-.049	128 (Ø14)	+3.020	6 (Ø33)	+.177	15 (E20)					3.1	4.6	14.26	1.61	4.1	6.6
521S	+21.94	-.481	19 (A03)	+.016	976.09 (A04)	-1.50	6.01 (A13)	-.26	85 (A19)	-.0004	1750 (Ø08)	+.637	10 (Ø23)	+.016	243 (E18)	7.38	1.19	8.78	1.64	26.2	43.0
5210																				8.8	14.4

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC2-2 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7)	= PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD *	PRESENT F-CLOCK VALUE =	METRIC MODEL ADJUSTED F-CLOCK
63RS	-2.4	-.26	3 (E13)	-.09	243 (E18)	+.12	54 (E19)	-.04	20 (E27)	+7.46	2.94 (E20)					4.30	1.75	7.53	1.61	7.8	12.5
			ENVIRONMENTAL MODEL																		
65BS	+.890	+.602	1 (A02)	-.026	24.13 (A09)	-.813	0.9 (Ø30)	+.008	69 (E09)							0.67	1.63	1.09	5.67	15.3	86.8
NOT	IN	KC-135A																			
71BS	-1.13	+.025	47 (A06)	+.004	620 (Ø15)	-.0074	10.3 (Ø27)	-.025	15 (E20)							2.07	3.18	6.59	0.53	27.4	14.5
71CS	-1.84	+.061	45 (A03)	-.044	20 (A18)	+.099	6 (Ø32)	+.006	120 (E03)	-.017	69 (E09)	+.142	15 (E20)			2.27	1.31	2.97	0.32	10.3	3.3
NOT	IN	KC-135A																			
72BS	-164	-7.70	2.14 (A02)	+.209	4 (A12)	+2.02	87 (A19)	+.0013	4000 (Ø11)	+.271	3 (E13)	+.14	15 (E20)			4.4	2.22	9.75	3.36	2.9	9.7
111S	-2.30	+.06	1 (F08)	+.027	150 (Ø05)	+.013	58.1 (Ø21)	-.08	15 (E20)							1.43	4.19	31.13	0.42	7.3	3.1
	+18.24	-.10	100 (F07)	-.005	620 (Ø15)	+.031	58.1 (Ø21)	-.04	10.3 (Ø27)	-.03	243 (E18)					6.0					
----	-27.2	+.021	1157 (F04)	-.006	1750 (Ø08)	+.50	115 (Ø12)	-.10	128 (Ø14)	+.016	58 (Ø21)	-.33	3 (E13)	+.24	15 (E20)	34.44	1.00	34.44	0.86	---	---
11A0																				18.8	16.2
11J0																				8.9	7.7
11K0																				11.9	10.2
116S																				86.9	74.7
1160																				43.5	37.4
117S																				144.9	124.6
1170																				48.3	41.5

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC2-3 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A +	(B1 *	X1) +	(B2 *	X2) +	(B3 *	X3) +	(B4 *	X4) +	(B5 *	X5) +	(B6 *	X6) +	(B7 *	X7)	= PEMAD *	AMAD / PAMAD =	TOTAL EMAD	AMAD / EMAD	PRESENT F-CLOCK * VALUE =	METRIC MODEL ADJUSTED F-CLOCK
12AS	-2.08	+.001	1750 (Ø08)	+.013	115 (Ø12)	+.003	62 (Ø17)	+.017	58 (Ø21)	-.004	104 (Ø25)	-.031	10 (Ø27)			0.69	1.67	1.15	0.87	138.3	120.0
12A0							OPERATIONS MODEL													276.6	240.0
13A0	-3.82	+.001	2960 (F03)	+1.2	1 (F06)	+1.74	1.3 (F13)	+.04	128 (Ø14)	+.01	581 (Ø19)					14.23	1.58	22.45	1.71	2.5	4.3
13CS	-31.32	+.128	90 (F09)	+2.0	1.2 (Ø03)	+.19	150 (Ø05)	+.007	88 (Ø26)	-.002	5200 (Ø31)	-.01	120 (E03)			1.9	1.36	2.58	6.84	5.4	36.9
1160	-2.5	+.002	1600 (F03)	+.86	5 (F06)	+.01	58 (Ø21)	-.09	15 (E20)							5.03	1.0	5.03	0.36	53.4	19.2
14B0	-.43	+.004	620 (Ø15)	-.002	62 (Ø17)	-.62	.03 (Ø34) OPERATIONS MODEL									1.87	9.57	17.89	0.37	14.2	5.3
14E0	+13.2	-.031	620 (Ø15)	+.19	58 (Ø21)	-.21	10 (Ø27) OPERATIONS MODEL									2.40	2.52	6.06	2.63	6.0	15.7
412S 4120	-.052	+.120	1 (F08)													0.07	51.00	3.47	1.43	31.1 46.1	44.4 65.9
421S	-1.29	+.904	0.48 (F13)	+.09	82 (Ø07)											0.62	12.05	7.47	3.07	4.2	12.9
NOT IN MODEL																					
451S	-1.8	+.017	150 (Ø05)	+.0001	9500 (Ø06)	-.0002	1750 (Ø08) OPERATIONS MODEL	+.002	128 (Ø14)	-.183	6 (Ø32)	+.172	6 (Ø33)			1.54	3.25	5.00	5.13	3.7	19.0
--- 461S	-1.72	+.686	3 (F16)													0.34	1.00	0.34	57.06	--- 14.6	--- 833.1
4620																				12.7	724.6
4630							EQUIPMENT MODEL													17.6	1004.2

KC-135A/CASTLE AFB LCOM
FAILURE CLOCK TRANSFORMATION WORKSHEET

TABLE DC2-4 CALCULATION OF ESTIMATED MAINTENANCE ACTION DEMANDS AND METRICS-MODEL-ADJUSTED F-CLOCK VALUES

FA LCOM F-CLOCK	PARTIAL ESTIMATED MAINT. ACTION DEMAND (PEMAD) PER UNIT EQUIP. PER YEAR (MAINT. METRIC REGRESSION ESTIMATING MODEL) A	+ (B1	* X1)	+ (B2	* X2)	+ (B3	* X3)	+ (B4	* X4)	+ (B5	* X5)	+ (B6	* X6)	+ (B7	* X7)	= PEMAD	* AMAD/PAMAD	= TOTAL EMAD	AMAD/EMAD	* PRESENT F-CLOCK VALUE	= METRIC MODEL ADJUSTED F-CLOCK
471S	-.02	+.37	0.9 (Ø30)													1.19	1.57	1.87	3.53	14.4	50.9
	-2.04	+.015	150 (Ø05)	-.0001	9500 (Ø06)	+.282	5.9 (Ø33)									0.31 0.88					
	OPERATIONS MODEL																				
494S	+.069	-.032	2.2 (F04)	+.009	9 (F08)											0.08	1.58	0.13	103.75	7.3	757.4
	EQUIPMENT MODEL																				

APPENDIX E

KC-135A LCOM SIMULATION
OUTPUT DATA FOR DIFFERENCE ANALYSIS

TABLE E1 KC-135A VALIDATION EXPERIMENTS LCOM SIMULATION RUN LOG

SIMULATED KC-135A AIR FORCE BASE	RUN NO.	CONFIGURATION	
		RANDOM NUMBER GENERATOR #7 SEED VALUE	FAILURE CLOCKS DERIVATION SOURCE
LORING (MAINE)	LSEED1 LSEED2 LSEED3	LCOM DEFAULT VALUE 0.333 0.797	ASD STANDARD VALUES
	LSEED4 LSEED5 LSEED6	LCOM DEFAULT VALUE 0.333 0.797	MAINTENANCE METRICS FOR LORING
	LSEED7 LSEED8 LSEED9	LCOM DEFAULT VALUE 0.333 0.797	1977 LORING DATA BASELINE
SEYMOUR-JOHNSON (NORTH CAROLINA)	SSEED1 SSEED2 SSEED3	LCOM DEFAULT VALUE 0.333 0.797	ASD STANDARD VALUES
	SSEED4 SSEED5 SSEED6	LCOM DEFAULT VALUE 0.333 0.797	MAINTENANCE METRICS FOR SEYMOUR-JOHNSON
	SSEED7 SSEED8 SSEED9	LCOM DEFAULT VALUE 0.333 0.797	1977 SEYMOUR-JOHNSON DATA BASELINE
CASTLE (CALIFORNIA)	CSEED1 CSEED2 CSEED3	LCOM DEFAULT VALUE 0.333 0.797	ASD STANDARD VALUES
	CSEED4 CSEED5 CSEED6	LCOM DEFAULT VALUE 0.333 0.797	MAINTENANCE METRICS FOR CASTLE
	CSEED7 CSEED8 CSEED9	LCOM DEFAULT VALUE 0.333 0.797	1977 CASTLE DATA BASELINE

TABLE E2 KC-135A/LORING AFB SIMULATION RESULTS, ASD STANDARD F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, ASD STD. F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	LSEED1	LSEED2	LSEED3	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	65.57	75.12	75.12	71.94
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	3.60	1.92	1.92	2.48
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	3.87	2.23	2.23	2.78
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	5.43	2.65	2.65	3.58
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	10.08	2.86	2.86	5.27
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.13	0.06	0.06	0.08
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	6.21	3.37	3.37	4.32
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	70.70	86.91	86.91	81.51
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	5.74	4.29	4.29	4.77
10. FLYING HOURS ACCOMPLISHED	2300.19	2360.92	2360.92	2340.68
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.48	2.59	2.59	2.55
12. ACTUAL MANHOURS USED	295.86	309.12	309.12	304.70
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	45.38	45.67	45.67	45.57
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	54.62	54.33	54.33	54.43
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.12	13.09	13.09	13.10
16. NUMBER OF REPARABLE GENERATIONS	1723.00	1825.00	1825.00	1791.00
17. PERCENT BASE REPAIR	62.27	56.33	56.33	58.31
18. PERCENT DEPOT REPAIR	37.73	43.67	43.67	41.69
19. AVERAGE BASE REPAIR CYCLE	3.45	3.39	3.39	3.41
20. PERCENT ACTIVE REPAIR	76.56	74.62	74.62	75.27
21. PERCENT WHITE SPACE	23.44	25.38	25.38	24.73
22. NUMBER OF ITEMS BACKLOGGED	168.00	223.00	223.00	205.00
23. NUMBER OF UNITS DEMANDED	1567.00	1662.00	1662.00	1630.00
24. PERCENT OF DEMANDS NOT SATISFIED	4.54	5.78	5.78	5.37
25. NUMBER OF ITEMS ON BACKORDER	2.00	1.00	1.00	1.00

TABLE E3 KC-135A/LORING AFB SIMULATION RESULTS, MAINTENANCE METRICS F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, METRICS F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	LSEED4	LSEED5	LSEED6	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	80.49	75.12	75.12	76.91
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.99	1.97	1.97	1.98
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	2.13	2.09	2.09	2.10
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	2.75	2.60	2.60	2.65
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	5.45	4.78	4.78	5.00
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.06	0.06	0.06	0.06
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	3.73	3.12	3.12	3.32
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	83.89	85.38	85.38	84.88
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.63	4.67	4.67	4.66
10. FLYING HOURS ACCOMPLISHED	2469.13	2420.09	2420.09	2436.44
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.65	2.50	2.50	2.55
12. ACTUAL MANHOURS USED	315.84	298.85	298.85	304.51
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	44.50	45.33	45.33	45.05
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	55.50	54.67	54.67	54.95
15. MAINTENANCE MANHOURS PER FLYING HOUR	12.79	12.35	12.35	12.50
16. NUMBER OF REPARABLE GENERATIONS	1863.00	1797.00	1797.00	1819.00
17. PERCENT BASE REPAIR	61.41	63.16	63.16	62.58
18. PERCENT DEPOT REPAIR	38.59	36.84	36.84	37.42
19. AVERAGE BASE REPAIR CYCLE	3.44	3.58	3.58	3.53
20. PERCENT ACTIVE REPAIR	78.86	77.98	77.98	78.27
21. PERCENT WHITE SPACE	21.14	22.02	22.02	21.73
22. NUMBER OF ITEMS BACKLOGGED	177.00	176.00	176.00	176.00
23. NUMBER OF UNITS DEMANDED	1677.00	1632.00	1632.00	1647.00
24. PERCENT OF DEMANDS NOT SATISFIED	5.13	6.50	6.50	6.04
25. NUMBER OF ITEMS ON BACKORDER	0.00	1.00	1.00	1.00

TABLE E4 KC-135A/LORING AFB SIMULATION RESULTS, 1977 BASELINE F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, 1977 BASELINE F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	LSEED7	LSEED8	LSEED9	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	77.32	78.05	78.05	77.81
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.94	2.05	2.05	2.01
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	2.19	2.13	2.13	2.15
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	2.81	2.71	2.71	2.74
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	5.40	10.99	10.99	9.13
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.05	0.06	0.06	0.06
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	3.27	3.30	3.30	3.29
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	84.34	78.77	78.77	80.63
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.48	4.71	4.71	4.63
10. FLYING HOURS ACCOMPLISHED	2370.08	2517.90	2517.90	2468.63
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.60	2.58	2.58	2.59
12. ACTUAL MANHOURS USED	310.20	307.60	307.60	308.47
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	44.80	45.25	45.25	45.10
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	55.20	54.75	54.75	54.90
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.09	12.22	12.22	12.51
16. NUMBER OF REPARABLE GENERATIONS	1985.00	1849.00	1849.00	1894.00
17. PERCENT BASE REPAIR	59.45	56.95	56.95	57.78
18. PERCENT DEPOT REPAIR	40.55	43.05	43.05	42.22
19. AVERAGE BASE REPAIR CYCLE	3.56	3.46	3.46	3.49
20. PERCENT ACTIVE REPAIR	80.13	75.64	75.64	77.14
21. PERCENT WHITE SPACE	19.87	24.36	24.36	22.86
22. NUMBER OF ITEMS BACKLOGGED	155.00	151.00	151.00	152.00
23. NUMBER OF UNITS DEMANDED	1814.00	1669.00	1669.00	1717.00
24. PERCENT OF DEMANDS NOT SATISFIED	5.68	8.51	8.51	7.57
25. NUMBER OF ITEMS ON BACKORDER	3.00	4.00	4.00	4.00

TABLE E5 KC-135A/SEYMOUR-JOHNSON AFB SIMULATION RESULTS, ASD STANDARD F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, ASD STD F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	SSEED1	SSEED2	SSEED3	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	76.92	77.42	77.42	77.25
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.71	1.80	1.80	1.77
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	1.98	2.09	2.09	2.05
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	2.47	2.64	2.64	2.58
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	3.83	7.45	7.45	6.24
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.06	0.07	0.07	0.07
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	3.52	3.11	3.11	3.25
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	86.43	82.84	82.84	84.04
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.33	5.83	5.83	5.33
10. FLYING HOURS ACCOMPLISHED	2144.44	2257.63	2257.63	2219.90
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.57	2.55	2.55	2.56
12. ACTUAL MANHOURS USED	306.49	304.38	304.38	305.08
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	46.79	46.55	46.55	46.63
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	53.21	53.45	53.45	53.37
15. MAINTENANCE MANHOURS PER FLYING HOUR	14.29	13.48	13.48	13.75
16. NUMBER OF REPARABLE GENERATIONS	1880.00	1990.00	1990.00	1953.00
17. PERCENT BASE REPAIR	59.63	54.37	54.37	56.12
18. PERCENT DEPOT REPAIR	40.37	45.63	46.63	43.88
19. AVERAGE BASE REPAIR CYCLE	3.46	3.60	3.60	3.55
20. PERCENT ACTIVE REPAIR	76.07	79.26	79.26	78.20
21. PERCENT WHITE SPACE	23.93	20.74	20.74	21.80
22. NUMBER OF ITEMS BACKLOGGED	247.00	213.00	213.00	224.00
23. NUMBER OF UNITS DEMANDED	1715.00	1823.00	1823.00	1787.00
24. PERCENT OF DEMANDS NOT SATISFIED	6.06	12.73	12.73	10.51
25. NUMBER OF ITEMS ON BACKORDER	19.00	10.00	10.00	13.00

TABLE E6 KC-135A/SEYMOUR-JOHNSON AFB SIMULATION RESULTS, MAINTENANCE METRICS F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, METRICS F-CLOCKS			3-RUN AVERAGE
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	
	SSEED4	SSEED5	SSEED6	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	76.92	76.67	76.67	76.75
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.75	1.92	1.92	1.86
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	1.97	1.93	1.93	1.94
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	2.61	2.72	2.72	2.68
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	2.93	4.90	4.90	4.24
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.06	0.06	0.06	0.06
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	2.67	2.77	2.77	2.74
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	88.01	85.69	85.69	86.46
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.66	5.01	5.01	4.89
10. FLYING HOURS ACCOMPLISHED	2192.06	2388.41	2388.41	2322.96
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.48	2.49	2.49	2.49
12. ACTUAL MANHOURS USED	295.87	297.64	297.64	297.05
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	45.73	46.11	46.11	45.98
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	54.27	53.89	53.89	54.02
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.50	12.46	12.46	12.81
16. NUMBER OF REPARABLE GENERATIONS	1945.00	1874.00	1874.00	1898.00
17. PERCENT BASE REPAIR	59.64	58.27	58.27	58.73
18. PERCENT DEPOT REPAIR	40.36	41.73	41.73	41.27
19. AVERAGE BASE REPAIR CYCLE	3.59	3.52	3.52	3.54
20. PERCENT ACTIVE REPAIR	76.99	75.18	75.18	75.78
21. PERCENT WHITE SPACE	23.02	24.82	24.82	24.22
22. NUMBER OF ITEMS BACKLOGGED	319.00	200.00	200.00	240.00
23. NUMBER OF UNITS DEMANDED	1779.00	1709.00	1709.00	1732.00
24. PERCENT OF DEMANDS NOT SATISFIED	7.87	5.73	5.73	6.44
25. NUMBER OF ITEMS ON BACKORDER	47.00	3.00	3.00	18.00

TABLE E7 KC-135A/SEYMOUR-JOHNSON AFB SIMULATION RESULTS, 1977 BASELINE F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, 1977 BASELINE F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	SSEED7	SSEED8	SSEED9	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	77.67	75.43	75.43	76.18
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	1.93	1.82	1.82	1.86
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	2.18	2.13	2.13	2.15
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	2.65	2.52	2.52	2.56
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	10.56	8.87	8.87	9.43
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.06	0.07	0.07	0.07
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	3.08	3.02	3.02	3.04
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	79.53	81.56	81.56	80.88
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	4.62	4.06	4.06	4.25
10. FLYING HOURS ACCOMPLISHED	2419.64	2275.63	2275.63	2323.63
11. PERCENT AVAILABLE MANHOURS UTILIZED	2.80	2.76	2.76	2.77
12. ACTUAL MANHOURS USED (100's)	334.65	329.76	329.76	331.39
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	52.41	51.28	51.28	51.66
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	47.59	48.72	48.72	48.34
15. MAINTENANCE MANHOURS PER FLYING HOUR	13.83	14.49	14.49	14.27
16. NUMBER OF REPARABLE GENERATIONS	2485.00	2567.00	2569.00	2540.00
17. PERCENT BASE REPAIR	52.52	49.44	49.44	50.47
18. PERCENT DEPOT REPAIR	47.48	50.56	50.56	49.53
19. AVERAGE BASE REPAIR CYCLE	3.97	3.98	3.98	3.98
20. PERCENT ACTIVE REPAIR	77.15	77.52	77.52	77.40
21. PERCENT WHITE SPACE	22.85	22.48	22.48	22.60
22. NUMBER OF ITEMS BACKLOGGED	280.00	531.00	531.00	447.00
23. NUMBER OF UNITS DEMANDED	2323.00	2412.00	2412.00	2382.00
24. PERCENT OF DEMANDS NOT SATISFIED	21.57	29.89	29.89	27.12
25. NUMBER OF ITEMS ON BACKORDER	23.00	215.00	215.00	151.00

TABLE E8 KC-135A/CASTLE AFB SIMULATION RESULTS, ASD STANDARD F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, ASD STD F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	CSEED1	CSEED2	CSEED3	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	74.20	76.97	76.97	76.05
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	2.85	2.83	2.83	2.84
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	3.47	3.18	3.18	3.27
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	3.39	3.79	3.79	3.66
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	16.05	13.03	13.03	14.04
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.07	0.07	0.07	0.07
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	5.82	5.62	5.62	5.69
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	73.65	71.49	71.49	72.21
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	7.44	6.08	6.08	6.53
10. FLYING HOURS ACCOMPLISHED	3501.45	3520.95	3520.95	3514.45
11. PERCENT AVAILABLE MANHOURS UTILIZED	3.57	3.67	3.67	3.64
12. ACTUAL MANHOURS USED	426.53	438.00	438.00	434.18
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	50.38	51.21	51.21	50.93
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	49.62	48.79	48.79	49.07
15. MAINTENANCE MANHOURS PER FLYING HOUR	12.19	12.44	12.44	12.36
16. NUMBER OF REPARABLE GENERATIONS	2709.00	3072.00	3072.00	2951.00
17. PERCENT BASE REPAIR	59.35	56.12	56.12	57.20
18. PERCENT DEPOT REPAIR	40.65	43.88	43.88	42.80
19. AVERAGE BASE REPAIR CYCLE	3.63	3.64	3.64	3.64
20. PERCENT ACTIVE REPAIR	74.08	74.87	74.87	74.61
21. PERCENT WHITE SPACE	25.92	25.13	25.13	25.39
22. NUMBER OF ITEMS BACKLOGGED (INSTANTANEOUS AVG)	278.00	276.00	276.00	277.00
23. NUMBER OF UNITS DEMANDED (TOTAL CUM)	2409.00	2746.00	2746.00	2634.00
24. PERCENT OF DEMANDS NOT SATISFIED	13.61	20.76	20.76	18.38
25. NUMBER OF ITEMS ON BACKORDER (INSTANTANEOUS EOP)	12.00	12.00	12.00	12.00

TABLE E9 KC-135A/CASTLE AFB SIMULATION RESULTS, MAINTENANCE METRICS F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, METRICS F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	CSEED4	CSEED5	CSEED6	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	70.72	74.01	74.01	72.91
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	2.71	2.66	2.66	2.68
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	2.74	2.89	2.89	2.84
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	3.84	3.59	3.59	3.67
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	20.00	16.10	16.10	17.40
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.08	0.07	0.07	0.07
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	4.62	5.05	5.05	4.91
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	66.01	69.65	69.65	68.44
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	9.06	6.14	6.14	7.11
10. FLYING HOURS ACCOMPLISHED	3320.49	3260.36	3260.36	3280.40
11. PERCENT AVAILABLE MANHOURS UTILIZED	3.10	3.22	3.22	3.18
12. ACTUAL MANHOURS USED	369.71	385.03	385.03	379.92
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	44.44	45.77	45.77	45.33
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	55.56	54.23	54.23	54.67
15. MAINTENANCE MANHOURS PER FLYING HOUR	11.13	11.81	11.81	11.58
16. NUMBER OF REPARABLE GENERATIONS	2266.00	2359.00	2359.00	2328.00
17. PERCENT BASE REPAIR	56.84	59.01	59.01	58.28
18. PERCENT DEPOT REPAIR	43.16	40.99	40.99	41.71
19. AVERAGE BASE REPAIR CYCLE	3.05	3.16	3.16	3.12
20. PERCENT ACTIVE REPAIR	76.58	76.05	76.05	76.23
21. PERCENT WHITE SPACE	23.42	23.95	23.95	23.77
22. NUMBER OF ITEMS BACKLOGGED	250.00	323.00	323.00	299.00
23. NUMBER OF UNITS DEMANDED	1989.00	2057.00	2057.00	2034.00
24. PERCENT OF DEMANDS NOT SATISFIED	10.16	9.04	9.04	9.41
25. NUMBER OF ITEMS ON BACKORDER	11.00	11.00	11.00	11.00

TABLE E10 KC-135A/CASTLE AFB SIMULATION RESULTS, 1977 BASELINE F-CLOCKS

CRITICAL OUTPUT VARIABLES MONITORED	SIMULATION RUNS, 1977 BASELINE F-CLOCKS			
	SEED #7=DEFAULT	SEED #7=0.333	SEED #7=0.797	3-RUN AVERAGE
	CSEED7	CSEED8	CSEED9	
	0-112 Days	0-112 Days	0-112 Days	
1. PERCENT SORTIES ACCOMPLISHED	75.33	74.51	74.51	74.78
2. PERCENT AVAILABLE AIRCRAFT DAYS IN SORTIE	3.05	3.07	3.07	3.06
3. PERCENT AVAILABLE AIRCRAFT DAYS IN UNSCHEDULED MAINTENANCE	3.31	3.27	3.27	3.28
4. PERCENT AVAILABLE AIRCRAFT DAYS IN SCHEDULED MAINTENANCE	3.77	4.07	4.07	3.97
5. PERCENT AVAILABLE AIRCRAFT DAYS IN NOT OPERATIONALLY READY - SUPPLY (NORS)	13.94	14.39	14.39	14.24
6. PERCENT AVAILABLE AIRCRAFT DAYS IN MISSION WAIT STATUS	0.07	0.08	0.08	0.08
7. PERCENT AVAILABLE AIRCRAFT DAYS IN SERVICE AND WAITING	5.38	5.22	5.22	5.27
8. PERCENT AVAILABLE AIRCRAFT DAYS OPERATIONALLY READY	70.47	69.91	69.91	70.10
9. AVERAGE AIRCRAFT POST SORTIE TIME (HOURS)	5.99	7.14	7.14	6.76
10. FLYING HOURS ACCOMPLISHED	3804.31	3729.72	3729.72	3754.58
11. PERCENT AVAILABLE MANHOURS UTILIZED	3.58	3.44	3.44	3.49
12. ACTUAL MANHOURS USED (100's)	427.17	410.91	410.91	416.33
13. PERCENT MAINTENANCE MANHOURS IN UNSCHEDULED MAINTENANCE	49.50	49.39	49.39	49.43
14. PERCENT MAINTENANCE MANHOURS IN SCHEDULED MAINTENANCE	50.50	50.61	50.61	50.57
15. MAINTENANCE MANHOURS PER FLYING HOUR	11.23	11.02	11.02	11.09
16. NUMBER OF REPARABLE GENERATIONS	2595.00	2568.00	2568.00	2577.00
17. PERCENT BASE REPAIR	62.16	59.00	59.00	60.05
18. PERCENT DEPOT REPAIR	37.94	41.00	41.00	39.95
19. AVERAGE BASE REPAIR CYCLE	3.44	3.39	3.39	3.41
20. PERCENT ACTIVE REPAIR	76.00	73.73	73.73	74.49
21. PERCENT WHITE SPACE	24.00	26.27	26.27	25.51
22. NUMBER OF ITEMS BACKLOGGED	310.00	260.00	261.00	277.00
23. NUMBER OF UNITS DEMANDED	2282.00	2264.00	2264.00	2270.00
24. PERCENT OF DEMANDS NOT SATISFIED	8.59	10.38	10.38	9.78
25. NUMBER OF ITEMS ON BACKORDER	14.00	19.00	19.00	17.00

END

DATE